

**Department of National Defence
Chief of Research and Development
Ottawa, Ontario
K1A 0K2**

**Environmental Audit of
Defence Research Establishment
Ottawa**

November 1991

**Acres International Limited
Niagara Falls, Ontario**



Recycled Paper

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Executive Summary



1 Executive Summary

Under a commission from the Minister of National Defence, Mr. William Barton reviewed activities in chemical and biological defence within the Department of National Defence (DND) and Canadian Forces, and in December, 1988, recommended that a full environmental audit be performed at Defence Research Establishment Ottawa (DREO). DREO is located in a complex managed by the Department of Communications (DOC) on the Ottawa River at Shirley's Bay, west of Ottawa. DOC maintains the Communications Research Centre (CRC) at this site and DREO is a tenant of CRC. DREO is organized into two support divisions (Program Support and Administration) and four research divisions: Electronics Division (ED), Electronic Warfare Division (EWD), Protective Sciences Division (PSD), and Radar Division (RD). In March 1991, Acres International Limited conducted the audit of DREO in eight subject areas: environmental management, air pollution control, hazardous materials management, water pollution control, solid and hazardous waste management, hazardous materials emergency response, occupational health and safety, and natural and cultural resources management.

Environmental Management

Overall environmental management at DREO is handled very well, particularly for occupational health and safety, and particularly in the PSD. Delegation of responsibility for environmental management through the administrative chain of command is, however, somewhat informal, and the Chief of DREO should formally define all of the establishment's environmental management responsibilities in a manual, or standard operating procedure (SOP).

The PSD has conducted environmental screening as required by the Federal Environmental Assessment and Review Process (EARP) Guidelines Order; however, the other divisions have not. EARP screening is needed for all outstanding items on the DREO screening list. The EARP training provided to PSD staff should be extended to all division directors at DREO.

DREO should improve documentation of all safety procedures of all divisions including training of new employees, students, and visiting scientists; refresher safety training for all personnel; and regular safety inspections in all divisions.

Most of the regulations and guidelines required in Canadian Forces Administrative Order (CFAO) 36-55 ("Hazardous Materials Management") are held in the DREO library, but a few are needed to complete the collection.

Regular documented checks should be made at all areas of DREO off-site responsibility to ensure compliance with CFAO 36-50 ("Environmental Protection Management").

An external review should be undertaken in about two years to verify implementation of the recommendations of the present audit, and a full external audit should be conducted again in about five years.

Air Pollution Control

Ventilation systems in the chemical laboratories incorporate charcoal filters in the fume hoods. SOPs have been implemented for testing and changing the charcoal filter systems and for proper use of the fume hoods. Compliance with internal policies and procedures for preventing the release of chemical warfare (CW) agents or other hazardous materials is quite good. This, combined with the small quantities of chemicals used in experiments, limits the likelihood of releases of toxic chemicals to the atmosphere.

Responsibility for air pollution control is currently shared by DREO and CRC. DREO should take greater responsibility for ensuring that air pollution control systems meet all applicable workplace and environmental standards.

Spark arrestors could be placed ahead of the charcoal filters in the Building 5B exhaust system to preserve the filter integrity in the event of a fire. Alternatively, an automatic halon fire extinguisher system could be fitted to the fume hood.

Hazardous Materials Management

The management of hazardous materials is very good at DREO. The staff who handle chemicals are well trained and quite experienced. PSD SOPs and DREO safety manuals adequately cover the information needed for hazardous materials management at the establishment, except that guidance for handling non-CW-agent hazardous chemicals could be improved by incorporating references to the US National Research Council's (1981) "Prudent Practices for Handling Chemicals in Laboratories". The DREO practice of limiting amounts of CW agents stored or handled to small quantities is a good way to reduce the chance of a serious incident involving these materials.

Although inspections by outside agents are held, they have limited coverage. More comprehensive, well-documented inspection programs would be beneficial, along with greater enforcement of SOPs, safety manuals, and other applicable directives.

Chemicals are added to the inventory of chemicals upon receipt from Stores and deleted upon disposal of the container. To ensure effective inventory control, chemical inventories should be confirmed on a regular basis, approximately every two years. Compressed gas inventories are not maintained for individual laboratories, owing to the short residence time of most cylinders in the laboratory (which can be as short as 5 days), but an overall inventory of gas cylinders is maintained by Stores. CW-agent inventories include chemicals such as hydrogen cyanide that could be used as a CW agent but are available commercially. These commercially available highly toxic chemicals are carried on the supertoxic chemical inventories to provide more effective control of maximum amounts on hand. In concert with the annual review of supertoxic agent holdings, a

review should also be undertaken for the highly toxic compressed gasses, such as hydrogen cyanide, to ensure that amounts on hand are not in excess of research needs.

Water Pollution Control

CRC is responsible for water supply and wastewater management on behalf of DREO.

DREO has implemented SOPs to limit water pollution from laboratories and has confirmed compliance of Pilot Plant effluent with the local sewer use bylaw. A regular, documented inspection program is needed to ensure compliance with these SOPs, which could be improved by reference to the US National Research Council's (1983) "Prudent Practices for Disposal of Chemicals from Laboratories".

Solid and Hazardous Waste Management

Although disposal of all solid waste, including hazardous wastes, is the responsibility of CRC as landlord, DREO is registered as an Ontario waste generator. Hazardous wastes generated by DREO are mainly surplus chemicals and spent solvents. These are generated in fairly small quantities, with removal for disposal every 4 - 6 months. Within DREO, there is an effective system of recording waste types and quantities to assist CRC in complying with regulatory requirements.

The DREO waste storage facilities are appropriate and the responsible people are experienced and knowledgeable.

There are written SOPs for management of hazardous wastes but they do not include procedures for controlling access to hazardous wastes or for limiting quantities in storage. PSDSOP-04 and -05 should be revised to include such requirements.

Hazardous Materials Emergency Response

Information, procedures and equipment at DREO provide the capability to respond effectively to foreseeable hazardous materials emergencies. Notwithstanding, the essential information most likely to be required during an emergency should be consolidated into a concise, easy-to-use emergency response manual, which should apply to **all** areas at DREO where hazardous materials are handled, stored, or used. This manual should be developed in accordance with the National Standard for Emergency Planning for Industry.

The need for training of selected management members of the DREO emergency response network in appropriate aspects of crisis management should be evaluated.

The need for structural spill containment in the laboratory drainage system in Building 5B should be evaluated.

The PSD SOP on spill containment for non-CW-agent chemicals should be revised to include methods for responding to ruptured or leaking compressed gas cylinders.

The PSD SOP on incident reporting needs to be revised to reflect the spill reporting requirements of the Canadian and Ontario Environmental Protection Acts and there should be increased emphasis on reporting minor incidents, with a regular review to identify patterns suggesting a need for improvements in protocols.

Occupational Health and Safety

The work force at DREO is generally well trained, well equipped and well protected for occupational health and safety and the establishment's safety history is good. DREO has generally good safety procedures and good senior people who currently ensure that the procedures are followed. Documentation of inspections, training and planning for replacement of retiring personnel should be improved, however, to help ensure that the

existing safety culture of DREO is not diminished by the retirement of its senior people.

DREO is essentially self-regulated as far as health and safety is concerned and should consider establishing closer ties with Labour Canada through comparison of its practices with the requirements of the Canada Labour Code and through regular contact with a Canada Safety Officer.

Continuous monitoring of CW agents should be carried out whenever these are present in the laboratory, to supplement the low-flow alarms on the laboratory fume hoods. The design and performance of the source capture hoods in the Polymer Laboratory and the Pilot Plant should be reviewed to determine whether they provide adequate protection for workers in these facilities.

DREO should assume responsibility for the health and safety of contractors working at the establishment by requiring them to adhere to the same safety laws and directives as DREO staff, except when the provincial regulations that the contractors normally work under are more stringent.

WHMIS update training should be provided in the next 1 to 2 years.

Natural and Cultural Resources Management

Responsibility for natural and cultural resources management at the Shirley's Bay site lies with DOC unless a specific DREO-initiated project has the potential to affect these resources. EARP screening at DREO has not always addressed effects on natural and cultural resources for projects affecting the outdoor environment. Environmental screening procedures at DREO therefore need to be improved to ensure that potential effects of DREO-initiated projects on the natural and cultural environment are considered and mitigated where necessary, including effects on wildlife, botanical resources, aquatic resources, drainage patterns, erosion potential, water quality, air quality, noise levels, and historical and

archaeological resources. Review of the Federal Policy on Land Use for applicability should be included in the screening procedure.

The establishment's environmental management manual or SOP should assign responsibility for ensuring that articles of archaeological or historical interest are reported in accordance with CFAO 36-16 and the Ontario Heritage Act.

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1 Introduction



1 Introduction

The Chief of Research and Development (CRAD) is responsible for the research and development programs carried out by or on behalf of the Department of National Defence (DND) except for operational research, some aspects of personnel research, and some engineering development. Research in chemical and biological defence, which is only one component of the overall CRAD program, is carried out at the Defence Research Establishment Suffield (DRES), near Medicine Hat, Alberta, and the Defence Research Establishment Ottawa (DREO), just outside Ottawa, Ontario. In addition, some chemical and biological defence projects are carried out at the Defence and Civil Institute of Environmental Medicine in Downsview, Ontario, and under contract in Canadian industry and at Canadian universities, provincial research organizations and the Royal Military College, Kingston, Ontario.

In July 1988, the Minister of National Defence (the Minister) commissioned Mr. William H. Barton to conduct a review of research, development, and training activities in chemical and biological defence within DND and the Canadian Forces. The aim of the review was to ensure that such activities are, in fact, defensive in nature and are conducted in a professional manner with no threat to public safety or the environment.

Mr. Barton reported the results of his review in a document issued in December 1988 (the Barton Report). He recommended that full environmental audits be conducted as soon as possible of DRES and DREO. The Minister accepted that recommendation and said that the reports on the audits would be made public.

In September 1989, CRAD initiated a program to conduct environmental audits of DRES and DREO by engaging Acres International Limited (Acres) of Niagara Falls, Ontario, to prepare a manual, or protocol, to guide the audits. Acres visited both establishments; reviewed laws, regulations, policies, codes of good practice and existing audit protocols for applicability to the establishments; and prepared a manual outlining the process to be followed for the audits from initial planning through site visits to the reporting of audit findings. The environmental audit manual for DRES and DREO was delivered to CRAD in March 1990.

In November 1990, CRAD engaged Acres to conduct the environmental audits of DRES and DREO in accordance with the audit manual previously developed by Acres. The overall goals of the audits were

- to strengthen environmental management at the two establishments and to help implement DND's commitment to an 'anticipate-and-prevent' mode of operation rather than a remedial one
- to reassure management and the public that DND is giving adequate attention to environmental matters at the establishments.

The specific objective of the audits was to conduct a systematic and detailed investigation of local procedures and practices

- to verify their compliance with legal requirements, departmental policies, and accepted practices
- to identify and assess risks from unregulated practices
- to evaluate the effectiveness of environmental management systems.

The findings of the environmental audit of DREO are documented in the present report. A separate report documents the findings of the environmental audit of DRES. Sections 2 and 3 of the present report describe the audit scope and the organization and activities at DREO. Next, the findings of the audit are presented, broken down by major subject area, in Section 4. Within each subject area, the presentation of findings proceeds by giving an overall evaluation of establishment performance followed by the specifics of regulatory compliance, policy compliance, and observation of good practice. The final section of the report gives recommendations arising from the audit, broken down by audit subject area.

CRAD's Statement of Work for the audits is included as Appendix A to this report. The qualifications and experience of the audit team are introduced in Appendix B. Appendix C gives exclusion and screening lists prepared by DREO in compliance with the Federal Environmental Assessment and Review Process (EARP) Guidelines Order. Appendix D is a glossary of abbreviations and acronyms.

2 Audit Scope



2 Audit Scope

There are many definitions of 'environmental auditing'. The audit of DREO was generally consistent with the definition of environmental auditing given in the Environment Canada (1988) Enforcement and Compliance Policy for the Canadian Environmental Protection Act.

"Environmental audits are internal evaluations by companies and government agencies, to verify their compliance with legal requirements as well as their own internal policies and standards. They are conducted by companies, government agencies and others on a voluntary basis, and are carried out by either outside consultants or employees of the company or facility from outside the work unit being audited. Audits can identify compliance problems, weaknesses in management systems, or areas of risk."

An audit program does not replace existing environmental management programs but is primarily a **verification** program intended to confirm that the necessary environmental management programs do, in fact, exist and that they are in use as they should be. An audit is a methodical examination requiring collection and documentation of evidence rather than formation of an opinion based primarily on professional judgment. Audit evidence is gathered by inquiry, observation, and testing.

The audit program for DREO covered all activities in the laboratory buildings and test sites at the establishment that might affect human health or the environment, with primary emphasis on environmental effects and public health and safety. There was secondary emphasis on worker occupational health and safety, mostly as it relates to hazardous materials handling. Activities of personnel from other organizations who are working at the establishment were included in the audit only if these personnel are working under the responsibility of the Chief of the establishment. The audit was concerned with how research is conducted at DREO, but not with the type of research conducted there or with the justification for the research.

The audit concentrated on the situation at the time of the site visit. However, attention was also devoted to environmental management and control programs under development at the time of the site visit and to past situations with the potential to pose a risk to the public, the environment, or workers in the future.

The broad subject areas included in the environmental audit of DREO were as follows.

- Environmental management in general (adherence to DND policies, compliance with the federal government's EARP procedures, internal communications, implementation of the recommendations of the Barton Report, environmental monitoring, environmental protection training).
- Air pollution control (controls on emissions of contaminants to the atmosphere).
- Hazardous materials management, including transportation of dangerous goods (compressed gases; oxidizing, corrosive and dangerously reactive chemicals; toxic chemicals, including supertoxic chemical warfare (CW) agents; biological and infectious materials; radioactive materials; petroleum, oils and lubricants; PCB; pesticides).
- Water pollution control (water supply and wastewater management to control pollution of surface and ground waters).
- Solid and hazardous waste management (including chemical, biological, radioactive, PCB, and oily wastes).
- Hazardous materials emergency response (emergency planning, training, and response capability).
- Occupational health and safety, noise, Workplace Hazardous Materials Information System (WHMIS), and radiation and laser safety.
- Natural and cultural resources management (vegetation, wildlife, soil, pest control, historical and archaeological site management).

It is important to bear in mind when reading this report on the environmental audit of DREO that the phrase 'hazardous materials' is used in the broadest possible sense. A suitable definition is that given in Canadian Forces Administrative Order (CFAO) 36-55 ("Hazardous Materials Management"), which states that 'hazardous materials' "means dangerous substances, dangerous goods, hazardous commodities, and hazardous products such as poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or any other material that can endanger human health or well being or the environment if handled improperly". Hence, although the meaning of the term 'hazardous materials' would include supertoxic CW agents and infectious biological warfare agents, it also refers to the widest possible variety of materials generally classed as harmful or potentially harmful to human health or the environment.

The site visit portion of the environmental audit of DREO was completed during the period March 4 to 8, 1991. The audit was performed by a team of four individuals, three from Acres and one from RPR Consultants Inc. of Mississauga, Ontario. The relevant qualifications and experience of the audit team members are briefly summarized in Appendix B.

During the site visit at DREO, the environmental audit was conducted through the following steps.

- An initial briefing was held to introduce the goals, methods and agenda of the audit to establishment management and to introduce audit team members and establishment personnel involved in the audit to each other.
- The audit team was given an orientation tour of the establishment.
- The audit team gathered evidence by interviewing establishment personnel, reviewing records and documentation and examining facilities at the establishment.
- The evidence was evaluated to enable the auditors to develop an understanding of the procedural and engineering environmental control systems in place at the establishment and to assess the strengths and weaknesses of these control systems.
- At the conclusion of the site visit, the audit team held a debriefing meeting to inform establishment management of the findings of the audit.

The audit findings were then documented in the present report prepared for CRAD.

3 Setting

3 Setting

DREO is located on the western outskirts of Ottawa in a complex on the Ottawa River at Shirley's Bay (Figure 1). The site (Shirley's Bay site) is managed by the Department of Communications (DOC), which maintains the Communications Research Centre (CRC) there. DREO is a tenant at the CRC facility.

DREO conducts research in electronics, communications, radar, navigation, and the protection of personnel and equipment to strengthen the capabilities of the Canadian Forces. Research activities are concentrated in six primary areas.

- Use of space platforms to improve Canada's defensive capabilities and efficiency.
- Techniques to provide more precise and rapid information from radar about targets, particularly in the presence of interference from terrain and weather.
- Ways to protect Canadian Forces personnel, equipment and machines from the effects of nuclear radiation, CW agents and adverse natural environments.
- Computer-integrated navigation systems for marine vessels, helicopters, and land vehicles.
- Means of locating, identifying, intercepting, jamming, and deceiving enemy radar and radio communications.
- Approaches to maintaining communication channels under adverse propagation and interference conditions.

DREO is organized into six divisions as shown on Figure 2. The Electronics Division (ED), Electronic Warfare Division (EWD), Protective Sciences Division (PSD), and Radar Division (RD) are the research divisions. The Program Support (Telecommunications Liaison) Division (PS-TLD) and the Administration Division (AD) provide various support functions to the four research divisions. It should be noted that the 'Environmental Protection' section in the PSD is responsible for research on ways of protecting personnel and materiel **from** the environment, not for protection **of** the environment.

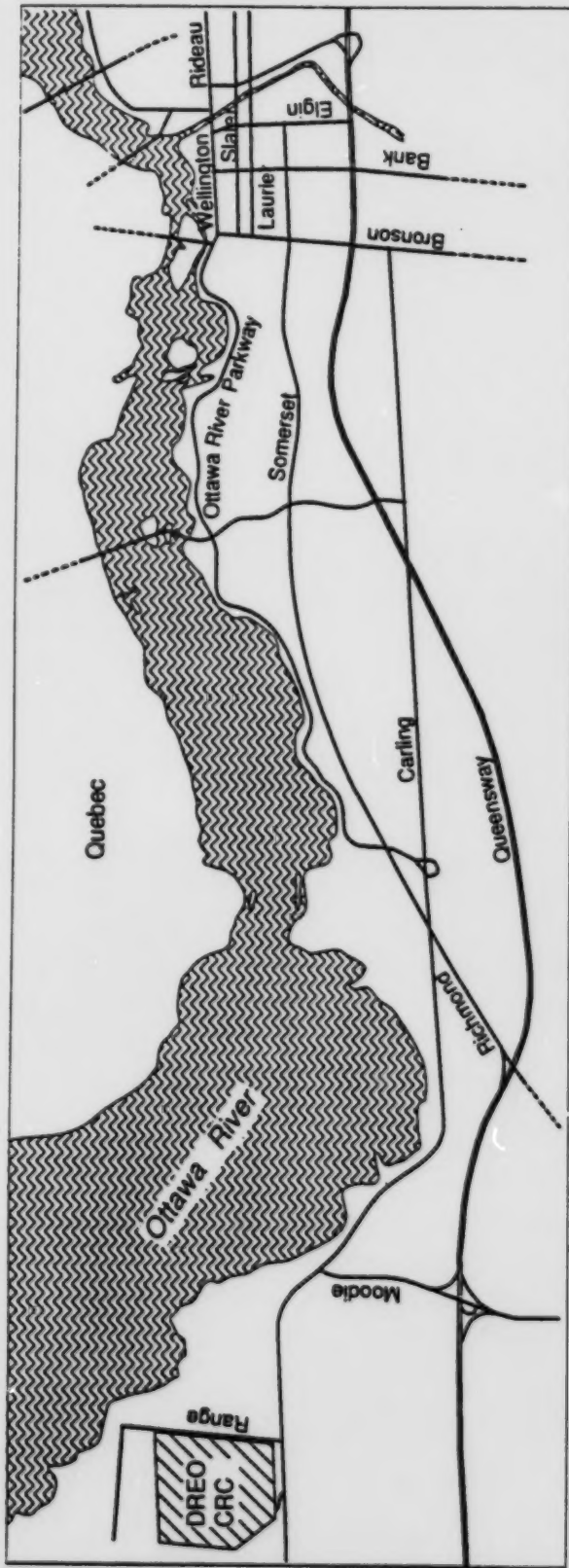


Fig. 1

Department of National Defence
Environmental Audit of DREO
Location Map



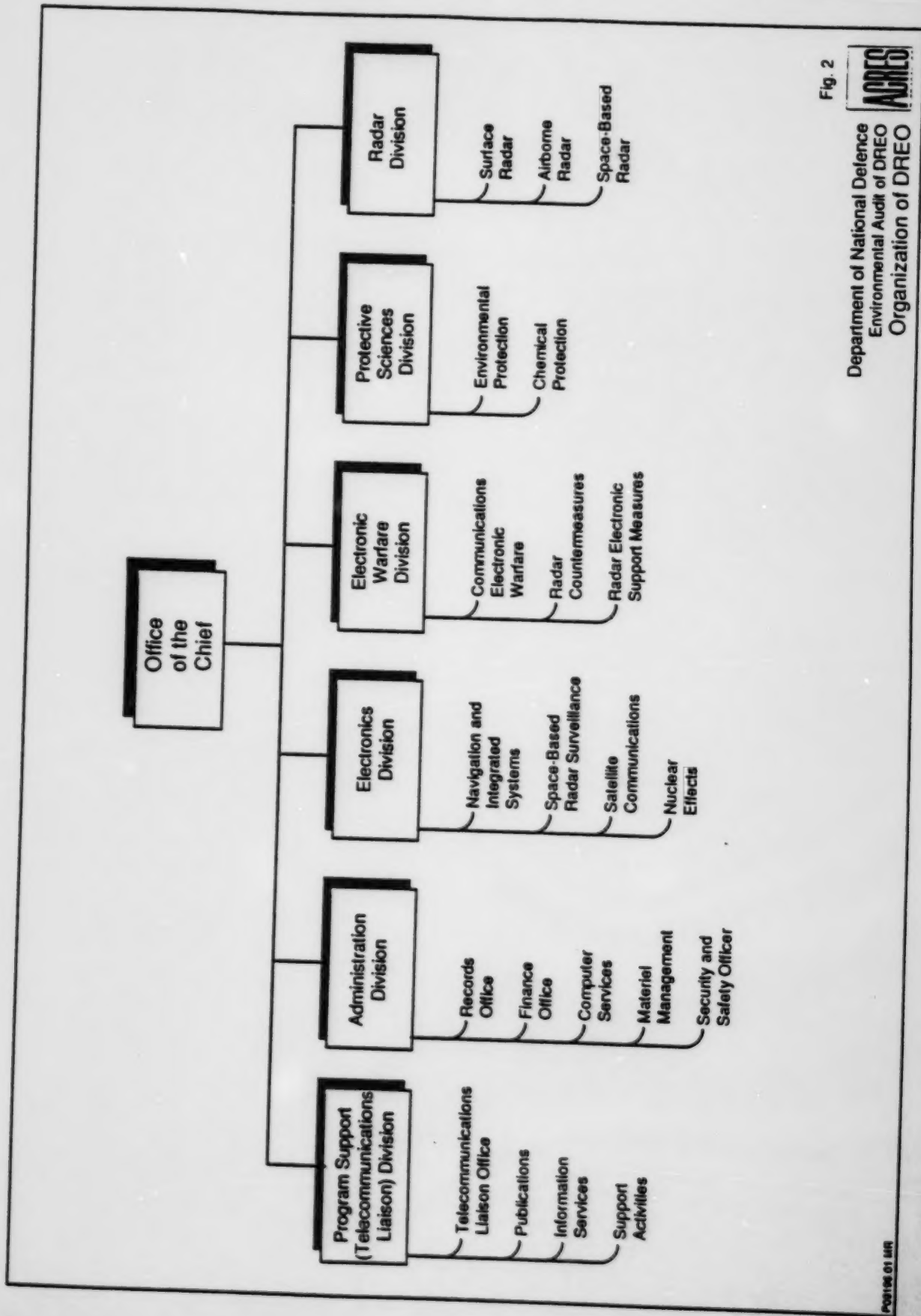


Fig. 2

Department of National Defence
Environmental Audit of DREO
Organization of DREO



The buildings occupied by DREO at Shirley's Bay are described in Table 1 and shown on Figure 3, except that Building 35 and Building 56 are in areas outside the area shown on Figure 3.

Buildings of particular concern to the environmental audit are

- 5B, 17, 29 and 73, which are the main sites of hazardous material or hazardous waste storage, handling or usage
- 9, the Pilot Plant, which contains a small paper machine used in research on specialty papers
- 5A, which contains the Polymer Laboratory, where research is conducted on specialty plastic and rubber compounds.

Table 1**Buildings Occupied by DREO at Shirley's Bay**

Building Number	Building Name	Description/Project
2B	DGRC/DGCD/RADAR	Communications Research
5A	Program Support, Electronics, Protective Sciences Divisions	Administration
5B	Protective Sciences Division	Chemical Laboratories
5C	Electronics and Protective Sciences Divisions	Electronics Laboratories
6	Administration	Physical Testing Group
9	Protective Sciences Division, Materials	Pilot Plant
10	Electronics Division	Defence Electronics Laboratory
13	Radar	Radar Research
17	Protective Sciences Division	Storage
22	Electronics Division	Defence Electronics
24	Nuclear Effects Section Extension	Protective Science
27	DSIS Records Storage Extension	Records Storage
28	Warehouse	Storage
29	Annex Building 5B	Main Stores, Shipping-Receiving
29A	Extension Gamma Beam Facility	Research
35	Explosive Storage Magazine	Storage
36	Electromagnetics Laboratory	Electronic Warfare Research
39	Incinerator Extension	Mechanical Laboratory
50	Radiation Experiments	Protective Science
52	Garbage Storage	Storage
56	Clothing Wear Lab	Protective Science
73	Fuel Storage Building	Storage
75	Electronic Research Facility	Radar Research
81	Storage	Storage



Legend
□ DREO Occupied Buildings

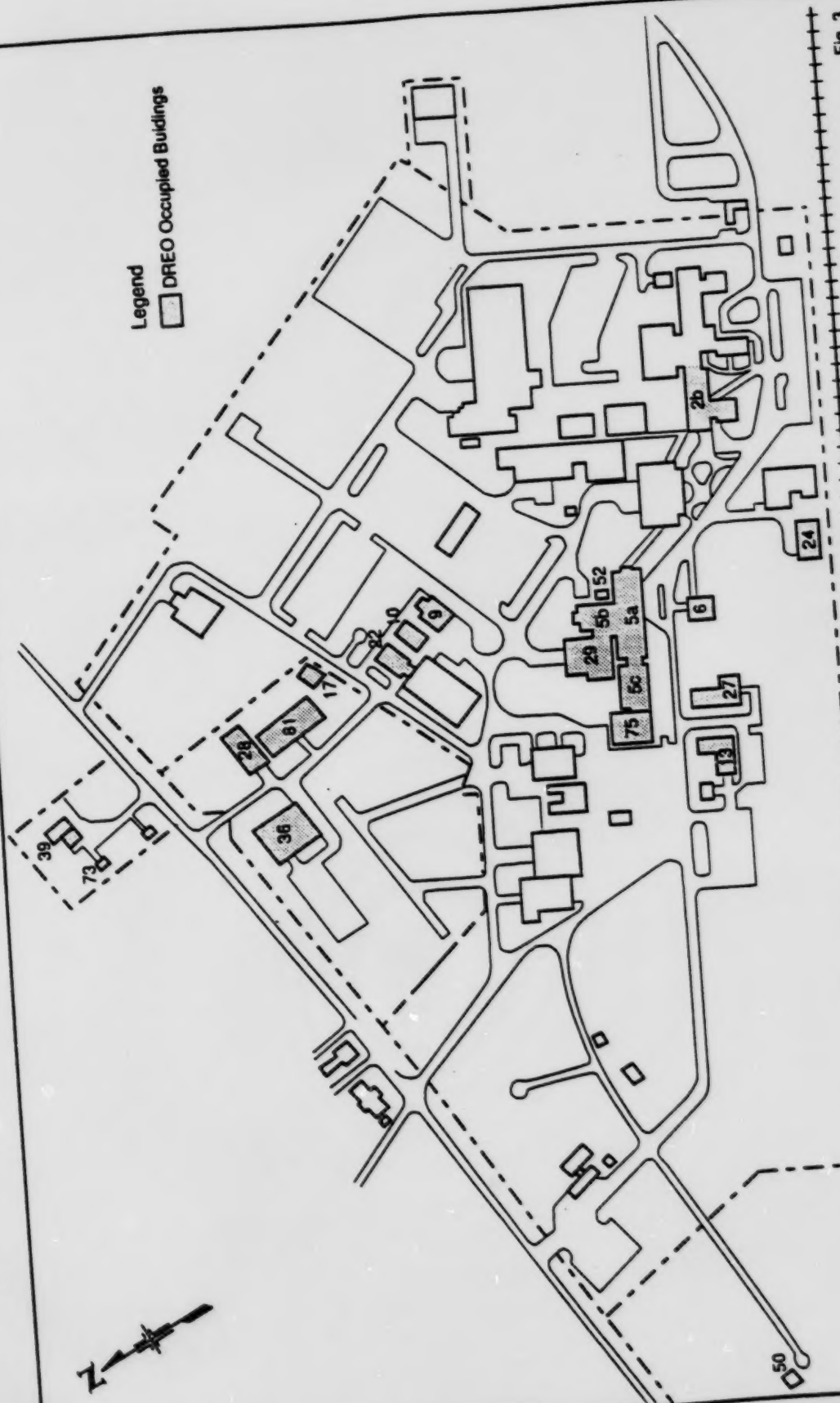


Fig 3

ADRES

Department of National Defence
Environmental Audit of DREO
Site Plan

4 Audit Findings



4 Audit Findings

4.1 Environmental Management

In this audit, environmental management refers to the overall environmental management systems in place at the establishment. Included are such aspects as compliance with the DND order on environmental protection management (CFAO 36-50), compliance with the Environmental Assessment and Review Process (EARP) Guidelines Order, adherence to the Federal Policy on Land Use, environmental monitoring and training, and response to the recommendations of the Barton Report. Environmental control procedures and facilities for specific subject areas such as air pollution, water pollution, or hazardous wastes are discussed in subsequent sections of this report.

4.1.1 Overall Evaluation

Generally, the overall environmental management responsibilities at DREO are handled very well, particularly where occupational health and safety is concerned (see Section 4.7) and particularly in the PSD.

Environmental management at DREO is handled through the normal administrative chain of command (Figure 2), which also includes research activities at the Radiobiology Laboratory at the University of Ottawa for which the Chief of DREO is responsible, and delegation of environmental management responsibilities is somewhat informal. Each individual division is responsible for ensuring that the proper policies and procedures are in place to ensure the safety of its staff and to protect the local environment. Each of the four research division directors interviewed was very aware of his responsibilities where occupational health and safety matters were concerned; however, only the Director of the PSD was aware of other environmental management responsibilities as currently required under the EARP Guidelines Order (see Section 4.1.2).

In the PSD, there is an excellent environmental management system in place. The Management Co-Chairperson of the DREO Health and Safety Committee reports to the Director of the PSD. The Chemical Safety Officer within this division is responsible for ensuring that all chemicals and chemical wastes are properly handled and disposed of in accordance with applicable regulations. An individual has been made responsible for environmental screening of all research activities within the PSD that have the potential to affect the environment.

In addition to routine staff responsibilities for environmental protection within the PSD, there is also considerable documentation in the form of safety manuals and standard operating procedures (SOPs) for environmental protection. PSD has therefore made a commendable effort to ensure environmental protection not only through allocation of staff resources but also through documentation of policies and procedures.

The other three research divisions (ED, EWD, and RD) also each have a safety officer. There is a Radiation Safety Officer in ED, a Laser Safety Officer in EWD, and a Microwave Safety Officer in RD. Each of these safety officers has some form of specialized safety manual for the principal research hazards in his or her division. These safety officers' formal responsibilities do not explicitly include environmental protection, although in most instances the policies and procedures for protecting workers also serve to protect the environment. At present, RD has an SOP on environmental protection (including health and safety), but ED and EWD do not. In all divisions, there is inadequate documentation of safety training for new employees, refresher safety training for all personnel, and routine safety inspections.

4.1.2 Regulatory Compliance

A key area of regulatory compliance not covered in any of the other portions of the audit is the EARP Guidelines Order, which has the force of law within the federal government.

The Chief of DREO has not ensured, through written directives to all division directors, that EARP requirements are followed. It should be noted, however, that the draft DND Environmental Assessment Manual (February 1991) indicates that DREO research and development activities are proposed for exclusion from EARP requirements in the near future. However, any new facilities or expansion of existing facilities would not be excluded from the requirement.

PSD has made considerable effort to comply with the EARP Guidelines Order. This is shown by the appointment of an individual to carry out environmental screening of PSD projects. Several environmental screenings have already been carried out and a few remain to be done. PSD also has a standard operating procedure (PSDSOP-24) for Initial Environmental Evaluations (IEE). This, however, is a misnomer since PSDSOP-24 really applies to environmental screening, or the initial assessment process, which could, in some cases, eventually lead to an IEE.

Similarly, the 'IEEs' already carried out by the PSD incorporate incorrect terminology and some include references to 'automatic exclusion' where they do not apply. The Director of the PSD and the individual responsible for EARP matters in the PSD have indicated their intention to rectify these instances of incorrect terminology. The DND Environmental Assessment Manual (when it is promulgated in final form) will be a useful guide for this purpose.

All four research divisions have prepared environmental exclusion and screening lists (see Appendix C); however, only the PSD has conducted environmental screening to date.

4.1.3 Policy Compliance

DND's overall direction on environmental management is given in CFAO 36-50 ("Environmental Protection Management"). This document adopts an 'anticipate-and-prevent' emphasis rather than a remedial one. DND's objective in environmental management is "to ensure that all Canadian Forces/DND projects are initiated, planned, implemented and made subject to monitoring, supervision or surveillance in a manner that fully considers the federal government commitment to both the maintenance of environmental quality and national security". Another directive in this general area is CFAO 36-55, ("Hazardous Materials Management"), which states that hazardous materials management shall be recognized as an essential factor in all planning in the Canadian Forces, with particular emphasis on identification, procurement, handling, storage, usage, transportation and disposal of such material. These two CFAOs have been accepted by CRAD as providing operational guidance to defence research establishments.

CFAO 36-50 ("Environmental Protection Management") requires

- (a) conformance with the EARP Guidelines Order
- (b) conformance with the Federal Policy on Land Use
- (c) conformance with hazardous materials management policy in CFAO 36-55
- (d) conformance with federal and provincial legislation and accepted environmental practices
- (e) incident reporting in accordance with CFAO 4-13
- (f) rectifying environmental damage caused by previous Canadian Forces/DND projects

- (g) participation in the annual Environmental Awareness Week
- (h) education of personnel in environmental protection, pollution control, the EARP and the Federal Policy on Land Use.

Item (a) is discussed in Section 4.1.2. Item (b) is primarily the responsibility of DOC, except that it is DREO's responsibility to assess conformance with the Federal Policy on Land Use when environmental screenings are undertaken on projects that affect land use (e.g., buildings or expansion of facilities), and this has not been done.

Item (c), hazardous materials management, is generally handled well for both CW agents and other hazardous chemicals. Procedures and staff resources are in place to ensure the proper storage, handling and disposal of hazardous materials. However, CFAO 36-55 also requires that certain reference materials and acts, regulations and guidelines be held in DND libraries¹. Most of the required materials were found in DREO's library. Those that were not found at the time of the audit were immediately placed on order by DREO. A few other regulations were recommended (although not required under CFAO 36-55) during preparation of the environmental audit protocol as being appropriate for holding in the DREO library. Some of these were found to be already present in the library at the establishment.

With regard to Item (d), DREO has not conducted environmental screenings in all research divisions (as it has in PSD) in conformance with EARP requirements. Since some of the items required in CFAO 36-55 were not in the DREO library at the time of the audit, it can only be assumed that DREO management is unaware, in at least a few instances, of environmental legislation with which it should comply to be in conformance with the DND policy of meeting the environmental protection responsibilities and pollution control standards and objectives in applicable federal and provincial statutes and regulations.

Item (e), incident reporting, appears to be handled well and in accordance with CFAO 4-13.

Item (f), rectifying environmental damage caused by previous DND projects, has been addressed at an old hazardous waste disposal site that is posted and fenced, although studies have discounted the hazard posed by this site.

¹ The list of reference materials in CFAO 36-55 is out of date. While a review of the relevance of these materials was not part of the audit, several references found at DREO should be added to this list.

DREO has participated in the annual Environmental Awareness Week (Item g) since 1990. Last year, Dr. H. Sadar from the Federal Environmental Assessment Review Office discussed the EARP process. This year, Dr. G. Cornwall from Environment Canada was scheduled to make a presentation on the Green Plan.

The education of personnel in environmental protection (Item h) has already taken place in several areas, including EARP training, occupational health and safety training, and emergency response training. However, the EARP training has been only for PSD staff to date.

Records of compliance with CFAO 36-50 directives are incomplete at DREO.

4.1.4 Observation of Good Practice

Generally, it was observed that DREO management (Chief and division directors) are conscientious with respect to protection of establishment staff, the immediate community, and the nearby environment.

4.2 Air Pollution Control

This portion of the audit is concerned with procedures and facilities for limiting emissions of contaminants from the establishment to the atmosphere and with whether such discharge causes, or is likely to cause, an adverse effect on humans or the environment. Indoor air quality control is addressed in Section 4.7.

4.2.1 Overall Evaluation

There are three principal emission sources at DREO

- laboratory fume hoods in Building 5B
- Polymer Laboratory, including canopy hoods and extruder hood
- Pilot Plant, including canopy hoods and grinding room.

Although there is a Certificate of Approval from MOE for the contaminant ventilation system in the Polymer Laboratory, in most respects air pollution control at DREO is regulated by internal policies and procedures developed primarily to protect workers at the establishment by preventing release of hazardous materials into the workplace. Compliance with these internal policies and procedures is quite good. Activities involving CW agent are conducted with small (microlitre) quantities of material for

limited time periods. The scale of operations in the Polymer Laboratory and the Pilot Plant is also quite small. DREO has rigorous procedures for transporting CW agent from storage to laboratory including double containment. There are charcoal filters in the Building 5B fume hoods to provide additional containment, and the existing SOP on these filters specifies replacement of the filters every 2 years or immediately if there is an accidental release of supertoxic CW agent. These various measures combine to limit the potential for release of contaminants into the atmosphere and prospects for virtually complete containment of toxic emissions at DREO are good.

Although the present inventory of emission sources is well known, there is no clear mechanism for ensuring that the inventory is updated when processes or materials are changed. If a change requires new or modified air handling systems for workplace contaminant control or air pollution control, the present arrangement is that CRC will design and install the equipment and obtain a Certificate of Approval from the Ontario Ministry of the Environment (MOE). Experience with the recent installation in the Polymer Laboratory has shown this arrangement to be time-consuming and not entirely satisfactory in its final result.

Responsibility for air quality protection is essentially split between DREO and CRC. No single individual reports to the Chief of DREO for air pollution control at the establishment.

DREO does not conduct or record emission monitoring, ambient air monitoring, calibration checks of monitoring equipment, or performance tests on air pollution control devices. Agency notifications have taken place in one instance (MOE - Certificate of Approval for the Polymer Laboratory), and flow measurements are performed on a regular basis for the laboratory fume hoods in Building 5B.

4.2.2 Regulatory and Policy Compliance

It is DND policy (CFAO 36-50) to meet the environmental protection responsibilities and pollution control standards and objectives in applicable federal and provincial statutes and regulations, subject to operational requirements. Ontario regulations for air pollution control are the most relevant at DREO.

Laboratory Fume Hoods in Building 5B

There is no Certificate of Approval for the emission of contaminants from Building 5B. It is likely that there is virtually complete containment of toxic

chemicals in the fume hood charcoal filters; however, this has not been documented by monitoring of emissions.

Polymer Laboratory

A Certificate of Approval (Air) has been obtained from the MOE for the contaminant ventilation system in the Polymer Laboratory.

Pilot Plant

Certificates of Approval have not been obtained for the contaminant ventilation systems in the Pilot Plant. These systems were installed to control potential health hazards to Pilot Plant personnel during activities such as charcoal capacity testing with carbon tetrachloride and grinding of materials in the grinding room.

4.2.3 Observation of Good Practice

Laboratory Fume Hoods in Building 5B

For work conducted in Building 5B, DREO has a zero emission policy for all potential air pollutants. This is certainly a prudent position to take considering the toxicity of the materials handled there. "The DREO CW-Agent Safety Manual" and various written SOPs have a direct bearing on the likelihood and control of any release of contaminant that might become airborne.

PSDSOP-03 addresses the testing, servicing, maintenance and replacement of fume hood charcoal filters in Building 5B. The Chemical Safety Officer (CSO) is assigned the responsibility of Fume Hood Filter Manager.

PSDSOP-23 addresses the use of fume hoods including the proper position of the front sash, visual checking of performance, periodic measurements of flow rate, and the operation of low-flow alarms. The CSO is required to conduct random inspections of fume hood log sheets.

All experimental procedures in Building 5B must be approved by the responsible supervisor. Personnel are required to be prepared for all possible problems that might lead to the release of hazardous materials into the fume hood or the laboratory.

Compliance with internal policies and procedures aimed at preventing the release of CW agents or other hazardous materials is quite good. The laboratory fume hoods are the main engineering control on the potential hazard presented to

laboratory personnel. The charcoal filters in the fume hoods are the air pollution control in the event of a release of contaminant in the laboratory or the fume hood itself. An emission to the atmosphere would not occur unless the charcoal filters failed in some way.

Polymer Laboratory

The contaminant ventilation system in the Polymer Laboratory does not incorporate any collection media to remove the particles and vapors that may be present in the air captured above the extruder and other pieces of equipment in the laboratory, as these emissions are not significant from an outdoor air pollution standpoint.

Pilot Plant

Modifications to the contaminant ventilation system in the grinding room were being discussed at the time of the audit. No data was available on the specifications or performance of these systems.

When Ontario passes the Clean Air Program legislation, the establishment may be required by the DND policy on compliance with provincial legislation to register all air emission sources and to apply for Certificates of Approval for each one.

4.3 Hazardous Materials Management

This portion of the audit is concerned with the proper routine storage, handling, and transportation of hazardous materials from the time the establishment assumes custody of the material or synthesizes it until the time that the material is designated as a waste for disposal. Handling and storage of hazardous wastes is addressed in Section 4.5. Hazardous materials emergency response is addressed in Section 4.6.

4.3.1 Overall Evaluation

Hazardous materials used at DREO can be divided into three broad categories: radioactive materials, the supertoxic CW agents and highly toxic gases, and hazardous chemicals other than CW agents. This division of materials is based in part on the documentation and control procedures used.

At the outset, it should be noted that the management of hazardous materials is very good. The basic philosophy of giving a limited number of experienced personnel access to the materials and keeping only small inventories on hand is well embedded in the operation of DREO and is particularly effective as a means of protecting the

public and the environment. The staff handling chemicals are particularly well trained and tend to have considerable experience. It was apparent that there was a conscious effort on the part of DREO to not only comply with the letter of the regulations but also to act within the spirit of maintaining a safe operation for both those employed at the establishment and the public at large.

Hazardous chemicals are used at DREO almost exclusively by the PSD, with other divisions using only products such as adhesives, paint-cleaning agents, and photographic chemicals, all in fairly small quantities. In all cases, the quantities are very small compared to typical industrial use; and even more important, mechanisms are in place to ensure that control over quantities is maintained.

Access to the laboratory area of the PSD is subject to three levels of control: control at the entrance to the CRC property, control at the entrance to Building 5, and further access control at the entrance to the laboratories in Building 5B.

CW Agents

These agents are classified as supertoxic materials and at DREO are handled only by the PSD. In the past, DREO received such materials from other DND facilities; but in recent years and at present, the policy is that all requirements will be met by on-site synthesis, with storage on site in a secure facility and careful control to minimize use of these materials. Quantities of these materials in hand range from a few millilitres in the case of nerve agents to some tens of millilitres in the case of mustard. The inventory for these materials is maintained separately from that for the other hazardous chemicals, with close control and an annual review. In addition to the nerve agents and mustard, some other hazardous materials are also inventoried in this system and, hence, are not included in the non-CW-agent hazardous chemical inventory. These include compounds that have been or are thought possibly to be in CW stocks in some parts of the world, including materials such as hydrogen cyanide, cyanogen chloride, and phosgene that are also used as industrial chemicals. These chemicals are subject to some of the same controls as the CW agents, to provide more effective control of maximum amounts on hand.

Hazardous Chemicals (excluding CW Agents)

All non-CW-agent chemicals are purchased through the DREO Stores with recording of all purchases. Bulk materials purchased on a regular basis, such as solvents, acids, bases, paints, and adhesives, are inventoried into Stores, held there, and then drawn as required by the user divisions. Inventory control is computerized, and upper and lower limits for each item are set to trigger

purchasing while limiting total stocks held on the premises. All other chemicals are also purchased through DREO Stores and then moved directly to the ordering laboratory, normally one of the laboratories of the PSD. While receipt of the material is recorded, there is no automatic transfer of this information to the inventory of chemicals maintained by the PSD. An overall policy is in place that restricts purchases of chemicals to those needed for identified experiments and to only those quantities needed. Prior to implementing this policy, a major review of stocks was carried out and all chemicals in stock but for which there was no identified need were disposed of to an authorized disposal company. A computerized inventory of chemicals is maintained for PSD by an outside company and individual inventories of material are maintained for each laboratory. For various reasons, these inventories are not up to date, and an updating exercise is underway.

One compound, halon, that is stored in large quantities, is of concern because of its potential effect on the atmospheric ozone layer. Halon is used for fire suppression and can leak from the system. Inventory control for halon is by checking for losses annually to ensure that the system remains functional.

Radioactive Materials

Sources of radioactive materials at DREO range from large fixed sources used for intense gamma radiation to micro curie sources used for instrument calibration or forming part of measuring equipment. Atomic Energy Control Board (AECB) licenses are held by DND rather than by DREO, and in some cases, particularly hand-held instrumentation, the equipment can be used at a number of locations. All sources are licensed by the AECB and subject to inspection by AECB. Surveys of radiation outside large sources are carried out and, where needed, additional shielding is installed.

4.3.2 Regulatory Compliance

The major regulatory requirements relate to health and safety needs of the workplace and are covered in Section 4.7. Other applicable regulations which relate to controlling losses to the environment are discussed in Sections 4.2, 4.4 and 4.6. The Transportation of Dangerous Goods Act and associated regulations apply to shipment of hazardous materials to or from DREO. Two of the staff in the DREO Stores section are qualified in the procedures for packaging and documentation in accordance with Transportation of Dangerous Goods requirements, and everything

appears to be in place at DREO to comply with the requirements for material shipped out and to confirm the documentation of material received.

4.3.3 Policy Compliance

Compliance with CFAO 36-55 ("Hazardous Materials Management") is generally good. Responsibility for management of hazardous materials has been well integrated with the responsibilities of the DREO Health and Safety Committee and the administrative chain of command. The CSO coordinates hazardous materials management in the PSD, the primary user of hazardous materials at DREO, and serves as an ex-officio member of and technical advisor to the DREO Health and Safety Committee. The hazardous material experts within PSD provide advice to other divisions on hazardous materials management. PSD has promulgated a series of 25 SOPs to provide direction for management of hazardous materials, training in hazardous materials, and responding to incidents involving hazardous materials. The current audit by Acres was commissioned by CRAD, not DREO; however, the PSD is working on establishing an on-going audit program to ensure compliance with all applicable policies, regulations, orders, and instructions related to hazardous materials.

4.3.4 Observation of Good Practice

Internal DREO procedures for hazardous materials handling and inventory control are contained in a series of PSD SOPs and DREO safety manuals. The SOPs outline general responsibilities, with the detailed procedures contained in separate documents referenced therein. PSDSOP-02 requires that an up-to-date inventory of chemicals in PSD laboratories be maintained (excluding CW agents, which are covered separately). A comprehensive inventory was set up in 1989 and is maintained as a computerized data base. Separate printed chemical inventories are maintained for each laboratory; however, the maintenance of the printed records for each laboratory is not consistent and the transfer of information to the computerized data base is such that the records do not give an up-to-date inventory of materials in stock. At the time of the audit, an update of the inventories was in progress.

PSDSOP-11 describes the inventory procedure for compressed gases. Because of the relatively high rate of usage of gases in the laboratories, the inventory is not maintained. The stores department does keep a record of cylinders received and shipped out so that accumulations of empty cylinders do not occur. During the audit, the number of cylinders in the laboratories appeared appropriate to the scale of the facility.

PSDSOP-14,-15 and-16 all relate to CW agents. The control of these materials is by well-defined procedures and by restricting access to senior, very well-qualified and experienced staff. Further, the policy requires double containment at all times and the use of minimum amounts of material. The Barton Report recommended an annual review of the CW agent inventory and this has been implemented as required by Defence Research Establishment Instruction 3/89. The measures in place and the ongoing consideration given to minimizing stocks used and amounts in inventory appear to be very effective in protecting the public in the event of mishap or emergency. More comprehensive procedures for dealing with CW agents are contained in "The DREO CW-Agent Safety Manual" and more generally for all chemicals, including CW agents, in an earlier document, "The DREO Safety Manual".

PSDSOP-25 outlines restrictions on storage of supertoxic agents in the laboratories. The quantities noted as upper limits for storage during silent hours appear to be more than would normally be used in the experiments carried out and, as such, there would seem to be little incentive to exceed these. Thus, although there can be no direct check on the compliance with this SOP, the procedures in place, the size of individual aliquots, and the total philosophy of operation would all indicate compliance.

The various PSD SOPs do not refer to any of the useful external reference works that are available on safe chemical handling, for example, the US National Research Council's (NRC) (1981) "Prudent Practices for Handling Hazardous Chemicals in Laboratories" or the American Chemical Society's (Young et al, 1990) "Developing a Chemical Hygiene Plan."

At DREO there is a great deal of emphasis on safe practices for use of CW agents. "The DREO CW-Agent Safety Manual" is a two-part work devoted to methods for security, storage, transport, laboratory use, production, and destruction of CW agents at DREO. The attention devoted to practices for safe use of non-CW-agent hazardous chemicals is considerably less. To a degree, this is appropriate because of the reduced hazard presented by many non-CW-agent chemicals. Written guidance for safe handling of non-CW-agent chemicals at DREO is provided primarily by the 36 pages of "The DREO Safety Manual" that deal with fire and explosion hazards and toxic and corrosive chemicals. This 1973 publication is being rewritten and updated to take account of new roles for DREO and the changes that have occurred since it was last updated.

4.4 Water Pollution Control

This portion of the audit is concerned with water supply and wastewater management at the establishment.

4.4.1 Overall Evaluation

DREO is a tenant of CRC, and CRC is responsible for water supply and wastewater management on behalf of DREO. Water supply and wastewater treatment services are provided by the Regional Municipality of Ottawa-Carleton.

Although CRC is responsible for maintaining the wastewater handling system at DREO, DREO has taken a number of initiatives to limit introduction of contamination into the sanitary sewer system.

- PSDSOP-10 specifies conditions under which chemical wastes in liquid or aqueous form may be flushed into the sewer to ensure that the disposal procedure satisfies the Regional Municipality of Ottawa-Carleton Bylaw 208 (sewer use bylaw), the Ontario Environmental Protection Act Regulation 309, and the Environment Canada "Reference Document for Contracting the Removal and Disposal of Hazardous Wastes at Federal Establishments in Ontario". PSDSOP-10 is intended to apply primarily to the Pilot Plant rather than to laboratories, but this is not entirely clear from the wording of PSDSOP-10.
- As part of the EARP screening for proposed modifications to the Pilot Plant (Building 9), wastewater from the paper machine was analyzed and found to be in compliance with the effluent limits given in The Regional Municipality of Ottawa-Carleton Bylaw 208 (sewer use bylaw).
- There is a program to keep plugs in laboratory drains when they are not in use in order to prevent accidental introduction of contaminants into the sewer system.

4.4.2 Regulatory Compliance

The Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments encourage the use of municipal wastewater treatment plants for treatment of sanitary wastewater, provided that the municipality, itself, complies with federal and provincial regulations or intends to do so within a reasonable time period. DREO does not maintain records to document compliance with this guideline on the

grounds that sanitary wastewater management at the establishment is the responsibility of CRC.

4.4.3 Policy Compliance

CFAO 36-55 ("Hazardous Materials Management") assigns bases, and possibly defense research establishments that are lodger units, responsibility for determining the applicable federal and provincial laws and regulations and municipal bylaws related to hazardous materials management. PSDSOP-04 and -10 indicate that the PSD has identified The Regional Municipality of Ottawa-Carleton Bylaw 208 and the Ontario Environmental Protection Act Regulation 309 as being applicable to disposal of chemical wastes from laboratories.

4.4.4 Observation of Good Practice

Little more than a decade ago it was common practice to dispose of most laboratory wastes down the laboratory drain. Today, the indiscriminate disposal of laboratory chemical wastes down the drain, without regard to quantity or type of chemical, is unacceptable (NRC, 1983). Prudent practice for disposal of chemical wastes down the drain includes

- disposal only into a drain system that flows eventually to a wastewater treatment plant and never into a system, such as a storm sewer system, that flows directly into surface water
- limiting quantities disposed of down the drain to not more than a few hundred grams or millilitres and flushing with at least 100-fold excess of water at the sink
- periodic monitoring or inspection by laboratory supervisors for adherence to guidelines on types and quantities of chemicals, rates, and flushing procedures.

Procedures and facilities for disposal of laboratory chemicals at DREO are generally consistent with these prudent practices. In fact, since spent solvents and corrosives are bottled and then removed from the establishment by a licensed disposal contractor, procedures at DREO exceed the above prudent practices in some instances. The laboratory drains at DREO are connected to the local sanitary sewer system, which conveys laboratory wastewater to a wastewater treatment plant, not to surface waters. PSDSOP-04 and -10 give procedures for disposal of chemical wastes into the sewer to ensure safe disposal consistent with applicable regulatory

requirements. What is missing is documentation of periodic monitoring or inspections for adherence to the SOPs concerned with disposal of chemical wastes into the sewer.

In the early 1980s, the US NRC developed guidelines for laboratories for the disposal of chemicals and recommended changes in laboratory procedures that would simplify the disposal of chemicals from laboratories in ways that would be safe and environmentally acceptable (NRC, 1983). The NRC's recommendations were formulated specifically for laboratory operations, where many types of chemicals are used in relatively small quantities, and not for operations such as manufacturing, where chemicals are used on a large scale. These recommendations include guidelines for disposal of chemicals into sanitary sewer systems that are more specific than the procedures contained in PSDSOP-04 and -10. These SOPs do not make reference to the NRC document on prudent practices for disposal of chemicals from laboratories.

PSDSOP-04 and -10 assign responsibility for providing recommendations for updating these SOPs to the Fume Hood Filter Manager, rather than to the Chemical Safety Officer, which does not seem entirely appropriate for a **water** pollution control responsibility.

4.5 Solid and Hazardous Waste Management

This portion of the audit is concerned with routine storage, handling and disposal of solid wastes and hazardous wastes from the time they are designated for disposal until they are properly disposed of. Handling and storage of hazardous materials before they are designated as wastes are addressed in Section 4.3. Hazardous materials emergency response is addressed in Section 4.6.

4.5.1 Overall Evaluation

Disposal of all solid wastes, including hazardous wastes, is the responsibility of CRC, as part of the overall operation of the total site, of which DREO activities form only part. An outside contractor (at the time of the audit, Laidlaw) undertakes off-site transportation and disposal as part of an overall contract with Public Works Canada. While the chain of responsibility is long, in practice the specific on-site arrangements for hazardous wastes are coordinated through one key individual, the CSO.

Historically, DREO carried out on-site disposal of hazardous wastes, which has been the subject of separate studies. At the present time, no on-site disposal of either hazardous or nonhazardous solid wastes takes place. There are also no activities being carried out at the old disposal areas.

Certain wastes, particularly all CW agents or items contaminated by CW agents, are treated in the laboratory to neutralize the agent prior to disposal. Waste materials awaiting disposal are reported to the CSO and kept either in the laboratory pending pickup or transported to a separate, locked, waste storage building. An inventory of material awaiting removal is prepared, and a separate inventory of material in the waste storage building is kept at that building.

DREO does not carry out radiochemistry work and, consequently, the generation of radioisotopic wastes at the establishment is limited to decayed fixed sources and some production of low-level, tritium-contaminated materials at the Accelerator.

4.5.2 Regulatory Compliance

DREO as a tenant is not considered a generator of waste for shipping, that function being the responsibility of CRC. DREO is, however, registered as a waste generator under Ontario regulations and does maintain an effective system of recording waste types and quantities. The DREO waste inventory is supplied to CRC to assist CRC in complying with its regulatory responsibilities for waste transport and disposal.

4.5.3 Policy Compliance

Compliance with CFAO 36-55 ("Hazardous Materials Management"), as it relates to hazardous waste disposal, is generally good.

4.5.4 Observation of Good Practice

Hazardous wastes generated by DREO are mainly surplus chemicals (chemicals that have not been used for more than one year) and spent solvents. The CSO collects chemical waste for disposal approximately every 4 - 6 months.

Because waste removal by the disposal contractor had been carried out not long before the audit, there was very little waste in storage. Consequently, direct observation of waste storage practices was limited. All materials stored appeared to be included on inventory. The facilities appear to be appropriate, and the responsible

personnel to be familiar with the requirements for separation of incompatible materials. DREO is considering recycling photographic chemicals, which tend to be produced in quantities that may warrant return to a recovery operation for spent photographic materials. Other wastes in the storage building were all in very small quantities.

Internal DREO procedures for chemical waste disposal are contained in PSDSOP-04 and PSDSOP-05 covering non-CW-agents and CW agents, respectively. Responsibility is clearly defined as resting with the CSO. PSDSOP-04 does not include reference to the waste storage building, to any limits on waste stored or to requirement for storing incompatible wastes separately. The procedure for flushing chemical waste down the drain when safe to do so is covered in Section 4.4. The procedures for other wastes appear to be followed, with labelling of material and recording in the inventory for the disposal contractor and at the waste storage building when the waste is moved to that location. However, as noted above, PSDSOP-04 does not include sufficient guidance to ensure safe storage such as by limiting the quantity of flammable waste stored in a building without fire protection, or in the same room as with other waste. With the very close control over the inventory of CW agents and the responsibility for drawing the material, for safety during use, and for final neutralization, all being with one person, the CSO, there is every reason to expect compliance with PSDSOP-05.

4.6 Hazardous Materials Emergency Response

This portion of the audit is concerned with contingency planning and emergency response for releases of hazardous materials into the workplace or the environment. The emphasis is on generic requirements and good management practices for minimizing the effects of releases of hazardous materials rather than on specific response actions for individual hazardous materials.

4.6.1 Overall Evaluation

Information, procedures, and equipment at DREO give the establishment an impressive capability for responding to accidental releases of hazardous materials, particularly in Building 5B, to limit exposure of workers, the public, or the environment. Trained and knowledgeable people are employed to work with hazardous chemicals and a comprehensive inventory of personal protective, spill response and first aid equipment is available. It is highly likely that DREO would be able to respond

effectively to emergencies involving CW agents or other hazardous materials at the establishment.

The first line of defence against a release of a hazardous material is to have in place programs and facilities to **prevent** such a release. At DREO, there is commendable emphasis on safety, as documented elsewhere in this report, to prevent accidents leading to the release of hazardous materials. This includes policies and procedures permitting only qualified personnel to work with the more toxic chemicals, decreasing the likelihood of accidental release and increasing the likely effectiveness of response to an accident involving the more toxic chemicals.

There are also procedures in place at DREO limiting work to small quantities of CW agents providing, in effect, a form of 'containment' since any accidental release would be limited to small quantities. Containment is also provided by procedures requiring work with CW agents to be done in approved fume hoods, by the charcoal filters in the fume hoods, and by keeping plugs in laboratory drains to prevent accidental introduction of hazardous chemicals.

An Emergency Response Team has been designated, and regular training is provided to improve the team's capabilities in hazardous materials emergency response. Training is provided by an outside consultant (Positive Action Group Ltd.) in Emergency Response Team coordination, self-contained breathing apparatus, hazardous materials management, fire theory, Emergency Response Team equipment, fire suppression, building systems, first aid, and cardiopulmonary resuscitation. Emergency response simulation exercises are conducted to expose the Emergency Response Team to simulated accidents. These simulation exercises are critiqued to identify areas where improvement is needed in the emergency response capability. Records at the establishment indicate that action is taken in response to these critiques.

Although an effective hazardous materials emergency response **capability** exists at DREO, it is not well supported by a comprehensive hazardous materials emergency response plan that presents essential information in a form easily usable in an emergency. Elements of such a plan do exist at DREO but are dispersed throughout a number of documents, such as "The DREO CW-Agent Safety Manual", various PSD SOPs, the Fire Manual, Material Safety Data Sheets, Agent Information Sheets, and Running Cards. A draft emergency response plan also exists, but it is more a guide for planning emergency response prior to an accident than it is a ready reference document to aid response during an accident. Many important details that

might be needed during an emergency are not contained in the draft emergency response plan but are contained in related documents where they are not readily accessible.

In summary, DREO has a sound capability to respond to hazardous materials emergencies, but deficiencies exist in the documentation to support that capability. The draft emergency response plan, which is currently under revision, should improve emergency response documentation at DREO.

4.6.2 Regulatory Compliance

The Canadian Environmental Protection Act, Section 36, is concerned with the release or likelihood of a release into the environment of any substance specified on the List of Toxic Substances in Schedule I of the Act. Any person who owns or has charge of such a substance immediately before its release or likely release or who causes or contributes to the release or increases the likelihood of release is required to

- report the matter to an inspector or to such a person as is designated by regulation
- make a reasonable effort to notify any member of the public who may be adversely affected by the release or likely release.

PSDSOP-21 ("Incident Recording and Reporting") does not include reporting procedures reflecting compliance with the Canadian Environmental Protection Act.

4.6.3 Policy Compliance

It is DND's policy (CFAO 36-50) to meet the environmental protection responsibilities and pollution control standards and objectives in applicable federal and provincial statutes and regulations, subject to operational requirements. Current spill-related legislation in Ontario is concerned primarily with reporting and cleanup of accidental releases of hazardous materials. For example, the Ontario Environmental Protection Act requires every person who discharges a contaminant or causes the discharge of a contaminant into the natural environment that causes, or is likely to cause, an adverse effect to notify the MOE of the spill, of the circumstances thereof, and of the actions that the person has taken or intends to take in response to the spill. As recent accidents involving hazardous materials at DREO have been contained within the laboratories at the establishment, there has been no occasion for reporting to

MOE in accordance with the Ontario Environmental Protection Act. However, PSDSOP-21 ("Incident Recording and Reporting") does not include provision for reporting to MOE, so the established written procedure for incident reporting at DREO does not reflect compliance with the Act.

CFAO 36-55 ("Hazardous Materials Management") requires bases, and perhaps defence research establishments that are lodger units, to include activities related to hazardous materials spill response with the responsibilities of the base Emergency Response Team. This CFAO specifies that the Emergency Response Team shall

- include individuals who are properly trained and equipped to handle spills of hazardous materials
- have knowledge of
 - regulations and guidelines relating to hazardous material spills
 - materials that they might encounter
- be familiar with the geography of the area where the spills may occur
- have listings of contractors available to undertake the cleanup of spills
- have contingency plans in place in the event that a spill is beyond their handling capability.

DREO is generally complying with this policy. Areas where compliance could be improved include

- knowledge of Canadian and Ontario Environmental Protection Act provisions on spill reporting (discussed above and in Section 4.6.2)
- documented contingency plans for major spills (discussed above and also below in Section 4.6.4).

There is a requirement to report major incidents, such as fire or personal injury, in accordance with CFAO 4-13 ("Unusual Incidents"). These reporting procedures are specified in PSDSOP-21 and "The DREO Safety Manual". It appears likely that these reporting procedures would be followed in the event of a major incident.

4.6.4 Observation of Good Practice

As prudent practice, it is the responsibility of every laboratory organization to have an emergency plan specifically for its facilities. The Canadian Standards Association recently produced a National Standard on Emergency Planning for Industry. This Standard establishes minimum criteria for emergency planning and provides guidance for the development of a plan for effective emergency preparedness and response. The Standard applies to all installations regardless of size or location that manufacture, process, use, handle, store, transport or dispose of dangerous substances. The National Standard on Emergency Planning for Industry lays out a planning process leading to the development of a concise, well-organized and comprehensive written emergency plan for dangerous substances. Although in many respects, emergency response planning at DREO is consistent with this Standard, improvements are needed to be fully consistent with the Standard.

Much of the information that should be included in a good hazardous materials emergency response plan exists at DREO, but it is dispersed throughout a number of documents, chiefly

- PSDSOP-01 ("Coordination of Emergency Response Training Sessions")
- PSDSOP-06 ("Use of Gas Masks")
- PSDSOP-12 ("Spill Containment of Chemicals - Nonhazardous")
- PSDSOP-13 ("PSD Emergency Equipment")
- PSDSOP-14 ("Containment of Supertoxic Materials")
- PSDSOP-21 ("Incident Reporting and Recording")
- PSDSOP-22 ("Use of Chemical Agent Monitor - CAM")
- "The DREO CW-Agent Safety Manual"
- "The DREO Radiation Safety Manual"
- Fire Manual
- Material Safety Data Sheets
- Agent Information Sheets
- Running Cards
- site maps showing hazardous areas to be avoided.

There is also a draft emergency response plan dated August 1988 covering many of the items of information that should be in an emergency response plan for hazardous materials. In many instances, this plan makes reference to PSD SOPs for details on the actions to be taken. The PSD SOPs, in turn, frequently make reference to yet other documents for detailed information. Hence, some of the detailed information

that could be needed in a hurry in an emergency is scattered throughout a number of documents. The draft emergency response plan is currently under revision.

The internal emergency response network consists of the following

- Chief
- DREO General Safety Committee
- Director of the Protective Sciences Division
- Head of the Chemical Protection Section
- Emergency Response Team Leader and Prime Members.

Only the Emergency Response Team Leader and Prime Members currently receive training in emergency response. Management members of the emergency response network do not receive training in crisis management appropriate to their likely role in an actual emergency.

PSDSOP-12 deals with spill containment of chemicals of low hazard relative to CW agents, such as organic solvents, acids, bases and inorganic salts. At DREO, these chemicals are often referred to as 'nonhazardous', because they are much less hazardous than the supertoxic CW agents. This usage can be misleading, however, because spilled organic solvents, acids and bases certainly can pose a threat to personnel or facilities if not properly contained and cleaned up. At present PSDSOP-12 does not include methods for responding to spills of highly volatile substances or to ruptured or leaking containers of compressed gas, but it is being updated to cover spilled solvents and highly volatile materials. An SOP for spill containment of hazardous chemicals or chemicals in large quantities is also under development.

There is no PSD SOP specifically for containment in the event of a spill of supertoxic agents similar to PSDSOP-12 for containment of a spill of non-CW-agent chemicals. For supertoxic agents, the emphasis in PSDSOP-14 is on containment to prevent release of supertoxic agent. Other relevant guidance is scattered throughout a number of PSD SOPs (01, 05, 06, 13, 21, 22).

Within PSD, minor incidents, such as the accidental spillage of a solvent, are entered in an Incident Log Book at the discretion of the individual(s) involved. Reporting for more significant incidents is through the DREO Health and Safety Committee and records of the incident and follow-up are maintained in the minutes of committee meetings.

A program has been initiated to provide spill containment in the Building 5B laboratories by leaving plugs in the laboratory drains when they are not in use. There are potential drawbacks to such a program, however.

- An aggressive inspection program is needed to ensure that the plugs are in place as they should be.
- Any delay in removing the plugs when there is release of a liquid that should be allowed to go down the drain could cause problems.

There is no structural containment in the form of holding tanks or the like as a backup for the program for containment by drain plugs. No formal analysis of possible worst-case accidents has been done to demonstrate that there is, in fact, no need for structural containment in the laboratory drainage system.

4.7 Occupational Health and Safety/Noise/ WHMIS/Radiation and Laser Safety

This portion of the audit is concerned with procedures and facilities for protecting workers at the establishment, primarily when working with hazardous chemicals, ionizing radiation, nonionizing radiation, or lasers. Adherence to WHMIS legislation is also considered in this portion of the audit.

4.7.1 Overall Evaluation

At DREO, there is a longstanding commitment to the protection of personnel working with CW agents, radioactive sources, and other hazards. As a result, the work force at DREO is generally well trained, well equipped and well protected for occupational health and safety. Since protection of people from exposure to workplace hazards also generally limits environmental exposure, the DREO health and safety program also provides a good measure of environmental protection.

At DREO, there are sound policies and procedures in place for worker health and safety. "The DREO Safety Manual" gives general guidance on all aspects of safety at the establishment. "The DREO CW-Agent Safety Manual" gives more detail on safety procedures for work with supertoxic agents and "The DREO Radiation Safety Manual" gives more detail on safety procedures for work with ionizing radiation. An introduction to safety at DREO is provided by "Capsule Facts on Safety for New

Employees". A manual on laser safety is being drafted. DREO subscribes to the Health and Welfare Canada Safety Code 6 for microwave radiation safety.

The DREO Health and Safety Committee has been formed in accordance with the requirements of the Canada Labour Code as a labor-management cooperative body and seems to function effectively. In addition, the following specialist safety officers have been appointed

- General Safety Officer (GSO)
- Chemical Safety Officer (CSO)
- Laser Safety Officer (LSO)
- Microwave Safety Officer (MWSO)
- Radiation Safety Officer (RadSO).

The health and safety history of DREO is good. However, the documentation in the form of training records, inspection reports and the like on how DREO's good safety record is achieved is somewhat lacking.

4.7.2 Regulatory Compliance

Part II of the Canada Labour Code (the Code), and associated Canadian occupational safety and health regulations and Treasury Board standards, are the relevant standards. Part II sets out the duties and responsibilities of employers, employees and safety and health committees. It provides the right to refuse work if danger is believed to exist by the employee. The regulations define in detail what is required by certain provisions in the Code.

A Canada Safety Officer has visited DREO only once in the many years that the present GSO has held his position. For all intents and purposes, DREO is currently self-regulating as far as the Code is concerned. For example, the Code requires a hazard investigation report or clerical assessment sheet for each dangerous substance when there is a likelihood that the safety or health of an employee may be endangered. The GSO is not aware of any such assessments, with the exception of Building 5B, where experimental procedures must be written up and approved by the responsible supervisor and the information contained in safety manuals and SOPs would appear to cover this requirement. The Code is not posted at DREO and reports on health and safety complaints, investigations, accidents and occurrences are not sent to Labour Canada. No work refusals requiring the attendance of a Canada Safety Officer have occurred.

4.7.3 Policy Compliance/Observation of Good Practice

In addition to the Canada Labour Code, DREO is also governed by DND P-40, P-41 and P-42, and various Canadian Forces Administrative and Medical Orders. The GSO has the primary responsibility to help the establishment meet these requirements.

The CSO is responsible to help the establishment use hazardous materials and CW agents and other hazardous chemicals safely. "The DREO CW-Agent Safety Manual" and PSDSOP-01 to -25 are the standard.

The LSO, RadSO and MWSO are responsible to help establishment personnel safely use devices that emit radiation. Laser SOPs and the content of laser safety training course manuals are the standard for safe laser use. Atomic Energy Control Board (AECB) licensing and use requirements and "The DREO Radiation Safety Manual" are the standard for safe handling of radiation equipment and isotopes. Health and Welfare Canada Safety Code 6 is the standard for safe use of microwave antennae.

General Safety

The GSO conducts regular inspections for general safety items such as fire prevention and personal protection to measure performance against the above requirements. Deficiencies are handled in several ways. Recommendations are given to the person responsible for the work area, then to the divisional director and finally to the Chief of DREO if action is not taken. The GSO reports to the Command GSO and fulfills annual reporting requirements to DND Headquarters.

Appropriate establishment professional, technical, and administrative personnel are trained in first aid, fire fighting, emergency response, and evacuation procedures. Fire extinguishers are inspected regularly by CRC. Noise levels do not approach or exceed 90 decibels in any work area.

Establishment training in WHMIS was coordinated by the GSO. Staff are due for an update. The GSO feels that Labour Canada should be giving some advice on the issue of repeat training.

The GSO called Health and Welfare Canada to investigate an indoor air quality complaint in the library, a situation that could have been referred to Labour Canada. The ties to Health and Welfare Canada have come about because medical examinations for establishment personnel are conducted there.

Chemical Safety

The PSD is inspected regularly by its own staff and by outside contractors. Safety Net, a local consulting company, is currently updating the inventory of hazardous chemicals (non-CW-agents). Labelling and Material Safety Data Sheet (MSDS) cataloguing are an ongoing task that is approximately 80% complete. The information is available, but a lack of clerical help has delayed production of a completed manual. All the data for CW agents is complete in one binder. The action items produced by the recent inspection of the laboratories by Safety Net are largely implemented. To the knowledge of the CSO, no inspection has been conducted by federal or provincial labor officers.

A hazard investigation report has not been prepared for each dangerous substance, although the "DREO CW-Agent Safety Manual", the PSD SOPs, and other safety memoranda are available and enforced through the review of all experimental procedures by responsible supervisors.

Health and Welfare Canada conducts annual medical examinations including cholinesterase tests and chest X-rays as required by the potential exposure in each job. Health and Welfare Canada does not conduct workplace inspections.

Workplace air is not monitored for the presence of contaminants on a regular or continuous basis as part of an exposure monitoring program when CW agents are in the laboratory. Laboratory fume hood airflow and face velocity are monitored regularly. A Chemical Agent Monitor is used as a detector in emergency situations.

The ventilation in Building 5B is a very important engineering control in the minds of the staff. It is operated, inspected, and maintained carefully. It can fail, but it does not usually fail without people noticing. A low-flow alarm, even at night, results in a phone call to the scientist in charge of the experiment from the security guard on duty.

The contaminant ventilation system in the Polymer Laboratory was installed to control potential health hazards to workers. There are, however, concerns about the design and performance of source capture hoods used in the system.

The use of personal protective equipment is required but left up to the individual. Recent employees are reminded frequently, but broader enforcement of safe practices is still required.

The DREO laboratories are inspected 2 - 3 times a year by the CSO in addition to the annual inspection by Safety Net. Inspections are sometimes conducted without any announcement. Inspections of fire and emergency equipment are conducted on a monthly basis.

At present, no check is made to ensure that new and updated MSDS are available to workers. The CSO intends to do this once a year starting this year, and the CSO also intends to review the WHMIS training documents for WHMIS update sessions. No training dates have been set.

Laser Safety

A laser safety subcommittee was formed in 1984 to resolve a medical examination issue (Health and Welfare Canada would not conduct the eye exams required by DREO). The committee met again in 1990 to review safety policy and an SOP for lasers.

Qualified personnel have been appointed as LSO and alternate LSO after completing a 1-wk laser safety course. The establishment has a formal laser safety program tailored to the specific laser systems under its control. Persons in charge of laser safety (PCLS) are designated in each laboratory using a laser. The PCLS are responsible to tell the LSO of anyone needing training. The LSO then trains that person. The LSO conducts random, unannounced and unrecorded inspections of lasers. Eight personnel can work with lasers. No accidents have occurred.

Due to proper equipment design and placement, the only deficiencies possible in existing laser installations at DREO are stray beams not properly controlled and improperly receiving visitors. Neither of these has happened. New installations are the main concern.

Electrical hazards due to the high voltage power supply are prevented by having the power supplies serviced off site.

DREO uses research contractors, both to build lasers and to work with them. It is not clearly defined who is responsible for the safety of contractors working at DREO.

Microwave Safety

DREO maintains an inventory of all significant radiofrequency radiation emitters, each properly designed and installed. A properly trained MWSO has been appointed, but a formal radiofrequency radiation safety program has not been implemented. Instead, project managers consult with the MWSO who applies the Health and Welfare Canada Safety Code 6 as a guide.

The MWSO monitors and investigates any reported problems and checks equipment and installations after changes. He specifies exposure levels and identifies restricted areas. To the knowledge of the MWSO (since 1970), there have been no incidents of radiofrequency radiation overexposure. The radiation monitor is currently being used to do survey work on the APS 116 radar project. This emitter is being modified and tested. It is attenuated from 500 kW to 50 W during testing.

According to the MWSO, DREO does not follow CFMO 41-03 since DREO is essentially a civilian site and is more appropriately guided by Health and Welfare Canada Safety Code 6 for safety in the use of radiofrequency radiation.

Radiation Safety

The RadSO has not taken the training prescribed by CFAO 34-24, but Director Clothing, General Engineering, and Maintenance (DCGEM) agrees that this is not necessary.

The establishment maintains a list of workers holding thermoluminescent dosimeters and considered as radiation workers. Each radiation worker is informed of the hazards and has undergone a medical examination consistent with the AECB license for that area. Health and Welfare Canada maintains records of exams. It is not clear if DREO does. The AECB Radiation Safety Handbook and its requirements are followed. Strong sources at DREO (6500 curie cobalt 60, 500 curie cobalt 60, Accelerator) cannot be operated without following the prescribed procedure, as interlocks are in place. DREO has a program to monitor all radiation workers and uses survey meters (required by AECB license) to prevent nonemergency exposure from exceeding the maximum permissible dose. There have been no overexposures to ionizing radiation in the last 5 years.

Radiation detection devices are all operational and have been calibrated within the last 1 to 2 years. A semi-annual inspection is done to ensure that all sources are appropriately labelled. Personnel movements are recorded in a log book in each

vault. A source usage log book is also maintained. An annual compliance report is prepared for the Accelerator.

All sealed sources of ionizing radiation are tested for leaks every 6 months or immediately following any incident that might have damaged the seal. Leak test records are kept.

There is no documented radiation worker training program. There are only six radiation workers and staff turnover is very low. Students and visiting scientists working in the area of a radiation source are given verbal briefings and are closely supervised.

Records required by C-02-040-003/TD-000 Part 12 are kept by the establishment (inventory, swipe tests, other AECB records).

Last year's DCGEM annual inspection was canceled. All deficiencies from the previous DCGEM inspection were rectified. AECB conducts compliance inspections at the establishment, most recently in May 1989, for radioisotopes and the Accelerator. Semiannual reports to DND Headquarters and the Command RadSO have been filed.

4.8 Natural and Cultural Resources Management

This portion of the audit is concerned with plans and programs for the protection and management of soil, water, plants, wildlife, archaeological resources, and historical resources at the establishment.

4.8.1 Overall Evaluation

DOC is the landlord at the Shirley's Bay site, so DREO has responsibilities as a tenant only for

- activities within the buildings occupied by DREO staff
- DREO research and development activities outside on lands under DOC's jurisdiction.

Accordingly, primary responsibility for natural and cultural resources management at the Shirley's Bay site lies with DOC unless a specific DREO-initiated project has the potential to affect these resources. In this case, DREO's environmental screening

under the EARP Guidelines Order would need to address natural and cultural resource management issues. This has not always occurred for projects affecting the outdoor environment. For example, a study was done in 1990 on the environmental impact of the electromagnetic pulse simulator near Building 39. While the key issue, the effects of electromagnetic radiation on personnel and equipment, was addressed, there should also have been some discussion of the effects (or lack of effects) on natural and cultural resources as a result of a change in land use on the site. While this may seem trivial in comparison with the electromagnetic radiation issue, it is important for DREO to ensure EARP compliance by addressing all possible effects and mitigation opportunities during an environmental screening.

4.8.2 Regulatory Compliance

Apart from deficiencies in EARP screening noted above, no instances of DREO noncompliance with the federal or provincial legislation associated with natural or cultural resources were noted during the audit.

4.8.3 Policy Compliance

No instances of DREO noncompliance with federal policies on natural and cultural resources management were observed. There is no indication, however, that the Federal Policy on Land Use, CFAO 36-16 ("Archaeological Finds"), and the Ontario Heritage Act have been considered in planning at DREO.

4.8.4 Observation of Good Practice

A tour of the grounds surrounding the DREO buildings found little disturbance to the natural habitat in the area. Several wildlife species, including deer, groundhogs, foxes and rabbits, are supported.

There was no indication of significant soil erosion problems, although, if there were, it would normally be the responsibility of DOC to deal with the problem unless it were the direct result of a DREO-initiated project.

5 Recommendations



5 Recommendations

5.1 Environmental Management

A manual or standard operating procedure (SOP) on environmental management should be prepared to provide guidance to staff at DREO. This should include, but not necessarily be limited to, the following

- a definition of the establishment's environmental management responsibilities as defined by CFAO 36-50, CFAO 36-55, CFAO 36-16, the Environmental Assessment and Review Process (EARP) Guidelines Order, and any other applicable federal, provincial, and municipal environmental legislation
- assignment of responsibilities for ensuring the establishment's compliance with this legislation (including areas of off-site responsibility)
- assignment of responsibilities for making regular (e.g., annual) environmental management reviews within each division and providing written documentation to the Chief on the division's compliance following each review
- assignment of responsibilities for ensuring that EARP training courses are provided for the Chief, each division director, and any other staff who may be involved with environmental screenings under EARP
- assignment of responsibilities for ensuring that any mitigation recommendations made during EARP environmental screenings are implemented prior to commencement of a project activity.

All activities on the DREO screening lists that have not yet been screened should be screened as soon as possible.

PSDSOP-24 should be renamed to reflect its actual subject (environmental screening), revised to reflect correct terminology, and made applicable throughout DREO (not just within PSD), or incorporated into the environmental management manual or SOP recommended above.

The EARP training that has been provided to PSD staff should be extended to all division directors. Also, DREO should ensure that refresher environmental training is provided on

a regular basis and that, as employees change responsibilities, they are provided with the appropriate environmental training.

Documentation of health and safety procedures should be improved in all divisions, including training of new employees, students and visiting scientists and refresher safety training for staff in all divisions and areas of off-site responsibility. The results of all safety inspections should also be fully documented, including followup actions.

Given the generally good compliance at DREO with legal requirements, DND policies and accepted practices, it would be inappropriate to repeat this environmental audit in the near future. A review in about two years to verify implementation of the recommendations of the present audit would seem appropriate, with a full repeat audit in about five years.

5.2 Air Pollution Control

DREO should take greater responsibility for ensuring that air pollution control systems at the establishment meet all applicable workplace and environmental standards. This responsibility should be assigned to one individual reporting to the Chief of DREO. This individual should be well informed about the needs of the establishment and familiar with Ministry of the Environment officials and requirements.

To preserve the integrity of the charcoal filters in Building 5B and prevent air emissions in the event of a fume hood fire, spark arrestors should be placed in front of the filters. Alternatively, an automatic halon fire extinguishing system could be fitted to the fume hoods.

5.3 Hazardous Materials Management

A primary factor in protecting the public is the control on quantities of chemicals. For those materials of relatively high toxicity that are stored as gases, or liquified gases, and that could be released outside the laboratory or storage area in the event of rupture, a review should be undertaken in concert with the annual review of supertoxic CW agent holdings to ensure that amounts on hand are not in excess of research needs.

At present, chemical inventory control on an ongoing basis is not fully effective. The update now underway will bring the system up-to-date. To ensure effective inventory control, chemical inventories should be confirmed on a regular basis, approximately every two years.

Almost all hazardous chemicals used at DREO are used by PSD, and typically are handled by a very well-trained and experienced staff. Maintenance of safety procedures, particularly for CW agents, is the responsibility of the Chemical Safety Officer (CSO), who not only has the responsibility for the safety of the procedures but also carries out such procedures as agent manufacture and transport to the laboratories from the storage building. Planning for the retirement of the current CSO is required to ensure continuity of safety procedures and approval processes as an integral part of safe materials management. This should include more comprehensive documented inspection programs to increase enforcement of PSD SOPs, safety manuals, and other applicable directives.

In revising "The DREO Safety Manual" and various PSD SOPs, DREO should consider including references to such works as the US National Research Council's (1981) "Prudent Practices for Handling Hazardous Chemicals in Laboratories" and the American Chemical Society's (Young et al, 1990) "Developing a Chemical Hygiene Plan" where appropriate to increase the level of essential detail readily available for the guidance of laboratory personnel.

5.4 Water Pollution Control

A regular, documented inspection program should be instituted to ensure compliance with the provisions of PSDSOP-04 and -10 for preventing disposal of unsafe amounts of chemical wastes into the sanitary sewer system and with other policies for preventing accidental introduction of laboratory chemicals into the sanitary sewer system.

In PSDSOP-04 and -10, reference should be made to the US National Research Council's (1983) report, "Prudent Practices for Disposal of Chemicals from Laboratories", and these SOPs should include more details about prudent practices for disposal of chemicals into the sanitary sewer system as necessary to give laboratory personnel ready access to the information needed to ensure safe disposal of chemicals in a manner that prevents water pollution.

PSDSOP-10 should be revised so that it is clear that this SOP applies to the Pilot Plant rather than to the chemical laboratories.

The Chemical Safety Officer, rather than the Fume Hood Filter Manager, should probably be assigned responsibility for providing recommendations for updating PSDSOP-04 and -10.

5.5 Solid and Hazardous Waste Management

As all wastes are stored in a single building, without any sprinklers or other fire suppression system, it would be appropriate to designate maximum quantities by waste class and to mark in the building areas for storing incompatible materials. This would become important if larger quantities of waste were generated by some future experiment, and would help during any transfer of responsibilities to other staff. PSDSOP-04 and -05 should be modified to include specific reference to the use of the waste storage building as well as to the limits noted above. Access control to the building should also be formally defined.

5.6 Hazardous Materials Emergency Response

The essential information most likely to be needed in a hurry during a hazardous materials emergency should be consolidated in a concise, easy-to-use emergency response manual to increase the likelihood of effective emergency response actions. This could be in the form of a stand-alone manual given force by a PSD SOP. The development of this material should be conducted in accordance with the Canadian Standards Association National Standard on Emergency Planning for Industry.

Coverage of the hazardous materials emergency response manual and the SOP for hazardous materials emergency response should extend to all areas at DREO where hazardous materials are handled, stored, or used.

The need for training in appropriate aspects of crisis management for selected management members of the DREO emergency response network should be evaluated.

The need for structural spill containment in the laboratory drainage system in Building 5B should be evaluated by assessing the threats posed by worst-case spills of solvents, corrosives and CW agents into laboratory sinks and floor drains to determine possible effects on the sewer system, wastewater treatment works and the environment.

PSDSOP-12 should be revised to include response procedures for ruptured or leaking compressed gas cylinders and this SOP should not refer to non CW agents that still can pose a hazard to personnel or facilities as 'nonhazardous chemicals'.

The requirement for reporting spills in accordance with the Canadian and Ontario Environmental Protection Acts should be incorporated into PSDSOP-21, to the extent consistent with the need to maintain national security. In addition, there should be

increased emphasis on logging of minor incidents, with a regular review of entries to identify patterns suggesting a need for improvements in protocols.

5.7 Occupational Health and Safety/Noise/ WHMIS/Radiation and Laser Safety

The establishment has good safety procedures and good senior people who currently insist that these procedures be followed. Some planning for replacement of retiring personnel should be carried out to ensure that the establishment's safety culture does not retire along with the senior people. Records of inspection procedures, specific checklists and results of past inspections would be useful for each Safety Officer's successor.

In some cases, retirement will remove the only person who currently knows how to do certain tasks. For example, the Accelerator can only be operated by one man. A computer-aided 'expert system' is being developed to replace this operator, who currently works under contract. DREO should take steps to address similar situations, to ensure continual safe operation of potentially hazardous equipment.

DREO should consider closer ties with Labour Canada. Comparison of DREO health and safety requirements with Part II of the Canada Labour Code and regular contact with a Canada Safety Officer are the most logical ways to continue external auditing of the health and safety program at DREO.

Continuous monitoring for CW agent should take place whenever agent is in the laboratory. Low-flow alarms on the fume hoods may not give adequate warning or may fail. The use of the Chemical Agent Monitor as an alarm during experiments would provide an extra measure of safety for laboratory personnel.

The design and performance of the source capture hoods in the Polymer Laboratory ventilation system should be reviewed with the aim of improving their capture efficiency and determining the required volume of air to be provided by the system fan.

The design and performance of the source capture hoods in the Pilot Plant should be reviewed to determine whether they provide adequate protection for workers.

The health and safety of contractors working at DREO should be clearly defined as DREO's responsibility. These personnel should be required to adhere to the same safety laws and directives as DREO staff when they are working at the establishment, except when the provincial regulations that the contractors normally work under are more stringent.

WHMIS update training based on a review of the previously taught material and any new Material Safety Data Sheets (MSDS) received should be provided in the next 1 to 2 years, as 1988 data sheets are replaced. (MSDS are updated every 3 years.)

5.8 Natural and Cultural Resources Management

DREO's SOP for environmental screening should ensure that impacts to the natural and cultural environment are considered and mitigation measures put in place where necessary. This should also include a review of environmental legislation and, where applicable, the Federal Policy on Land Use, to assess compliance of the proposed project being screened.

Responsibility should be assigned for ensuring that articles of archaeological or historical interest are reported in accordance with CFAO 36-16 and the Ontario Heritage Act.

References

References

National Research Council. 1981. **Prudent Practices for Handling Hazardous Chemicals in Laboratories.** National Academy Press, Washington, DC.

National Research Council. 1983. **Prudent Practices for Disposal of Chemicals from Laboratories.** National Academy Press, Washington, DC.

Young, J.A., W.K. Kingsley, and G.H. Wahl. 1990. **Developing a Chemical Hygiene Plan.** American Chemical Society, Washington, DC.

Appendix A
Statement of Work



STATEMENT OF WORK

ENVIRONMENTAL AUDITS OF THE DEFENCE RESEARCH
ESTABLISHMENTS SUFFIELD (DRES) AND THE DEFENCE RESEARCH
ESTABLISHMENT OTTAWA (DREO)

1. BACKGROUND:

In response to direction from the Minister of National Defence, the Chief of Research and Development (CRAD) has a requirement to carry out Environmental audits at DRES and DREO.

1.1 A contract (SSC W2181-9-AM29/01-SV) was awarded to Acres International Limited on 29 September 1989 to scope the project, identify those activities that should be examined and to provide an audit format. A generic audit protocol suitable for use at research and development establishments was produced in March of 1990 (copy attached). The document contains the detailed audit information and outlines the process to be followed from initial planning through site investigation to the reporting of the audit findings.

1.2 This manual will form the basis for the environmental audits at DRES and DREO.

2. REQUIREMENT:

To carry out a detailed environmental audit of the Defence Research Establishments at Suffield and Ottawa.

3. OBJECTIVES:

3.1 The objective of the appraisal is to conduct a systematic and detailed analysis of local procedures and practices leading to a verification of their compliance with legal requirements, departmental policies and accepted practices.

3.2 Additional audit objectives are contained in section 2 of the manual.

4. SCOPE OF WORK:

4.1 The initial audits will be broad in scope and cover both the physical environment and the health and safety of the inhabitants living and working in the environment.

4.2 The audit will examine but not be restricted to the following subject areas: (for details refer to section 6 of the manual)

- (a) environmental management;
- (b) air pollution;
- (c) all phases of hazardous material management;
- (d) water pollution;
- (e) emergency response plans;
- (f) occupational health and safety; and
- (g) natural resource management.

4.3 In addition to the basic scope contained in section 3, the study will examine the existing programs and projects to ensure compliance with the 1984 Order in Council on the Environmental Assessment and Review Process (EARP). The audit will examine the operations of the divisions and directorates to determine the degree of compliance of current and on going programs. In many cases the operating procedures and emergency plans in use in our laboratories and range areas should indicate that these processes fully comply with regulations policies and accepted practices. The consultant is required as part of the audit to identify those activities that do not meet acceptable standards and should be subject to screening under the EARP.

4.4 Para 11 of the 1984 EARP order in council states that all departments shall develop in co-operation with the Federal Environmental Assessment Review office a list identifying the type of proposals that would not produce any adverse environmental effects and that would as a result be automatically excluded from the process. The consultant shall produce a recommended exemption list for DRES and DREO.

- 4.5 The contractor will not be required to perform sampling or testing of soil and/or water. Areas of potential concern are to be included in the recommendations as requiring additional studies.
- 4.6 Should the contractor encounter activities or areas that he feels to be of extreme concern, he shall verbally notify the Establishment contact and the Scientific Authority without delay. Written notification shall be provided as soon as practical.
- 4.7 The contractor will not be required to examine in detail projects or studies designed to clean-up or improve the environment (ie. Project Swiftsure, Soil analysis studies being conducted by R.M.C.) He may at his discretion provide general comments on these type of activities.

5.

AUDIT PROCEDURES:

- 5.1 The procedures to be followed during the audit are outlined in detail in section 4 of the audit manual. A workplan detailing the pre-audit, audit and post audit phases will be developed by the consultant. The plan will identify the audit team members, the sequence and timing of activities and start and finish time and details included in each of the major phases.
- 5.2 The proposed work plan will be submitted to the scientific authority and approved prior the consultant submitting the previsit Environmental Management questionnaire contained in section 5 of the manual.
- 5.3 The timings for the audits at the establishments will be determined through negotiation with each establishment.

6.

SECURITY REQUIREMENTS:

- 6.1 All members of the contractors team will require a confidential level of security clearance. The clearance must be obtained before the individual members will be allowed access to classified material.

- 6.2 The contractor will not be required to retain or store classified material on his premises.
- 6.3 Since the report will be available to the public it must not contain classified material.

7.

REPORTS:

- 7.1 The report shall conform to the format contained in table 2 section 4-6 of the protocol.
- 7.2 The draft report shall be submitted no later than 6 months after the pre-audit questionnaire is sent to the establishment. DND shall review and provide comments to the contractor within 5 weeks of receipt of the draft report. The final report will be required one month after receipt of DND's comments.
- 7.3 Final reports shall be assembled in a series of individual volumes of approximately one inch thickness and covering all details observed during the study. The report shall be printed on standard sized paper, single space, and spiral bound on the left.
- 7.4 All photo representation contained within the reports shall be colour photocopied reproductions of photos taken during the study, to be included at appropriate locations within the descriptive text. Colour photos are to be supplied as a separate item as described at sub para 8.1.5.

8.

DELIVERABLES:

- 8.1 The contractor shall submit reports for the study as follows:
 - 8.1.1 Five copies of draft reports complete with a thorough and detailed photographic representation of all details contained within the report.
 - 8.1.2 Thirty copies of final reports complete with a thorough and detailed photographic representation of all details contained within the report.

- 8.1.3 The contractor is requested to quote on extra copies of the reports based on a minimum order of 12 copies.
- 8.1.4 Two copies of the final report shall be submitted individually on 3 1/2" computer discs and shall be compatible with WORDPERFECT™ software, Version 5.0.
- 8.1.5 One set of 35mm slides representing all photographs contained in the report and one set of 5x7 inch coloured prints.
- 8.1.6 Should the items described in 8.1.4 not be WORDPERFECT™ compatible, Version 5.0, the contractor must provide an original copy of the software used to assemble the report. The software used must be compatible with the MS DOS™ operating system.

9.0 PROGRESS MEETINGS:

- 9.1 Progress meetings will be held at the discretion of the Scientific Authority named herein. The agenda shall include but not be limited to:

- technical progress during the reporting period;
- activities planned for the next period;
- problems encountered or expected;
- labour and other costs incurred in the reporting period;
- labour and other costs estimated for the next period;
- action items, if any.

The Contractor shall produce minutes of these meetings, however these minutes shall be for record only and will not have executive authority.

10.0 PROGRESS REPORTS:

- 10.1 On a monthly basis the Contractor shall prepare and deliver to the Scientific Authority and the DSS Contracting Officer a short progress report of the previous month's activities, identification of any problem with proposed solutions, and proposed work for following month. These reports shall be delivered within the first five working days of each calendar month. These reports shall contain an updated Contract Plan and Report Form (DSS 9143).

CONTINUATION - SUITE

SEC the No. - N° de référence d'ASC

0178V.W2181-0-0M29

Contract No. - N° du contrat

W2181-0-0M29/01-SV

TITLE: ENVIRONMENTAL AUDITS OF THE DEFENCE RESEARCH ESTABLISHMENTS AT

SUFFIELD (DRES) AND OTTAWA (DREO), PHASE TWO

AT: Statement of Work - Appendix "A" - Item 9.1:

DELETE: "Progress meetings will be held at the discretion of the Scientific Authority named herein."

INSERT: "Progress meetings will be held at the discretion of the Scientific Authority named herein, to a maximum of three meetings."

AT: Statement of Work - Appendix "A" - Item 6.1:

DELETE: "All members of the contractors team will require a confidential level of security clearance."

INSERT: "Any members of the site visit team requiring access to classified material during the audit will require a confidential level of security clearance."

AT: Statement of Work - Appendix "A" - Item 4.3:

DELETE: "The consultant is required as part of the audit to identify those activities that do not meet acceptable standards and should be subject to screening under the EARP"

INSERT: "The consultant is required as part of the audit to assist DRES and DREO in identifying those activities which are likely to

- be placed on an exclusion list
- require a Class Assessment
- require mandatory Initial Environmental Evaluations
- not fall into any of the above categories and likely require environmental screening."

AT: METHOD OF PAYMENT Clause - page 5 of contract:

0178V.W2181-0-0M29

Canada

Appendix B

Audit Team



Kay Ashwood

- Project Manager, Environmental Services Division, Acres International Limited, Niagara Falls
- B.Sc. Biology and Environmental Studies
- B.A. Physical Geography and Environmental Studies
- Seventeen years of experience, with major assignments including
 - environmental management audit of Environmental Branch of the National Energy Board
 - protocol for environmental audits, DREO and DRES
 - hazardous material inventories and emergency response plans for pulp and paper industries
 - environmental assessment for gas pipelines, hydroelectric developments, mines, sediment cleanups and industrial developments
 - surveys of environmental assessment research funding, waste exchanges, Canadian cold regions research capability, environmental mapping techniques and occupational exposure to styrene, nickel and epoxy resins
 - literature reviews on high-level nuclear waste management practices and the effects of power plant emissions on building materials.
- Technical papers include
 - "Initial Environmental Assessment Procedures and Practices. Instructor's Manual" (for FEARO)
 - "Methodology for Developing a Quantity and Location Inventory of Hazardous Compounds in Ontario".

Ian Hill

- Regional Manager, Halifax, and Manager, Waste Management and Environmental Services, Acres International Limited.
- Ph.D. Civil Engineering
- B.Sc. Mathematics
- B.Sc. Civil Engineering
- Twenty three years of experience, with major assignments including
 - technical direction of the Sydney Tar Ponds Cleanup
 - municipal landfill site design
 - evaluation of municipal incinerator options
 - evaluation of contamination at an old coal gasification site
 - planning for upgrade of waste treatment at a dairy products plant
 - expert witness testimony related to the impacts of various spills and atmospheric emissions
 - removal of creosote/PCP liquid pool from Thunder Bay Harbour
 - contaminant investigations and remedial action plans at an oil refinery
 - cleanup work at a number of hydrocarbon terminals
 - cleanup plan for PAH-contaminated sediments
 - evaluation of contaminated foundry sands for treatment
 - cleanup of PCB spills
 - investigation of toxicity problems at a paperboard mill
 - advisory services on municipal and hazardous waste management.

Tom Robinson

- Vice President, Occupational Health and Safety, RPR Consultants Inc., Mississauga.
- Certified Industrial Hygienist.
- M.Eng., Occupational Health and Safety Engineering.
- B.Sc., Biology and Chemistry.
- Twelve years of experience, with major assignments including
 - walk through and monitoring surveys
 - chemical hazard control programs
 - evaluation and design of ventilation systems
 - design and implementation of complete occupational health and safety programs
 - background documents for Ministry of Labour on welding hazards
 - WHMIS training
 - asbestos abatement
 - national survey of hazardous heating and ventilation conditions in housing.
- Technical papers include
 - "Toxic Solvents"
 - "The Environmental Audit"
 - "A How-To Strategy for Implementing WHMIS".

Jim Tanner

- Project Manager, Environmental Services Division, Acres International Limited, Niagara Falls.
- M.Eng., Environmental Engineering.
- M.Sc., Physical Oceanography.
- B.Sc., Chemistry and Biology.
- Eighteen years of experience, with major assignments including
 - environmental audit protocol development, DREO and DRES
 - hazardous materials inventory at an airport
 - inventory of reception facilities in Canada for marine wastes
 - ship tank residue concentrations for the Great Lakes liquid bulk chemical trade
 - countermeasures for spills of 7 hazardous materials in Canadian waters, including audit of CCG capability to respond to marine spills of 7 hazardous materials
 - water pollution management studies for pulp and paper, mining, hydroelectric, airport and municipal facilities
 - stormwater quality management studies
 - water quality studies related to contaminated sediments
 - nearly 3 years as Communications Officer and Electronic Materiel Officer in a destroyer.

Appendix C

Federal Environmental Assessment and Review Process Exclusion and Screening Lists



EARP Exclusion and Screening Lists Electronic Warfare Division (EWD)

Exclusion List

- Low power radiofrequency power sources not capable of producing radiation exposure levels in excess of 10% of those in Health and Welfare Canada Safety Code 6
- Commercial and in-house developed (low power) electronic systems and subsystems
- Use of commercial computers and video display terminals

Screening List

- Use of lasers
- High power radiofrequency power sources capable of producing radiation exposure levels in excess of 10% of those in Health and Welfare Canada Safety Code 6
- Installation of research and development facilities on the Shirley's Bay site

EARP Exclusion and Screening Lists Electronics Division (ED)

Exclusion List

- Radiofrequency power sources
- Commercial and in-house developed electronic and mechanical systems and subsystems
- Commercial computers and video display terminals

Screening list

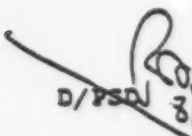
- Electromagnetic pulse testing system
- Radiation source use
- Laser use

Cops provided to Acres 1-12
Unit 2 E. Balance (3rd)
Billion.

MEMORANDUM

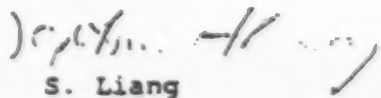
DREO 3754-1 (CPS/PSD)

07 March 1991


D/PSD 3/3/91

PSD AUTOMATIC EXCLUSION LIST
AND INITIAL SCREENING LIST

1. The PSD Automatic Exclusion List (Appendix A) must be consulted to determine if a PSD proposal of new programs/projects can be excluded from environmental screening under the Federal Environmental Assessment and Review Process (EARP).
2. Items have been included on the list because:
 - a. experience has shown that the environmental effects of these routine projects and activities are negligible; or
 - b. the proposals are carried out in response to circumstances that constitute an emergency and are in the interest of public health or safety.
3. PSD project/program proposals not in the Automatic Exclusion List need to be assessed for environmental effects. Such proposals undergo an initial screening and is grouped together in the Initial Screening List (Appendix B). The list removes the need to initiate separate initial environmental screening for similar projects.


S. Liang
CPS/PSD

Attachment: Appendix A, B

c.c. H/CPS
H/EPS

AUTOMATIC EXCLUSION LIST

- A. Field Testing of Clothing/Equipment in the Arctic or at Wearer Course.
- B. Research, development and evaluation of warm/cold clothing.
- C. Research, development and evaluation of equipment (e.g. sleeping bags).
- D. Research and development of structures (e.g. tents) for different climates.
- E. Physiology studies.
- F. Heat and mass transport study of clothing footwear and tents.
- G. Transport study of liquids (e.g. on textiles).
- H. Wind penetration study (e.g. on clothing).
- I. Theoretical study of heat and mass transport of agents.
- J. Study of heat loss from human body.
- K. Study of NBC hardened cold weather/combat clothing.
- L. Study on burners/heaters.
- M. Study of insulated tarpaulins for vehicles (cutting down infrared signature).
- N. Development of test protocol on NBC protective clothing.
- O. Study on storage of NBC barrier fabrics.
- P. Study on sweat poisoning of NBC protective clothing.
- Q. Application of CAD in chemical protection.

Appendix B to
DREO 3754-1 (CPS/PSD)
dated 07 March 1991

INITIAL SCREENING LIST

- A. Use of Toxic Agents (done).
- B. Impregnate Adsorbents (done for Rotacone).
- C. Synthesize Chemicals.
- D. Emergency Response Training (done).
- E. Chemical Storage (done).
- F. Aerosol Filtration Studies.
- G. Disposal of Chemicals.
- H. Paper Maker (done).
- I. Charcoal Impregnation of Materials.
- J. Material Finishings/Lamination.
- K. Compounding and processing of Polymers.
- L. Testing of Polymers, Paper and Clothing (includes polymer lab, pilot plant and physical test lab).

Glossary of Abbreviations - 2

MSDS	Material Safety Data Sheet
MWSO	Microwave Safety Officer
NRC	US National Research Council
PCB	Polychlorinated Biphenyl
PCLS	Persons in charge of laser safety
PSD	Protective Sciences Division
PS-TLD	Program Support (Telecommunications Liaison Division)
RadSO	Radiation Safety Officer
RD	Radar Division
SOP	Standard Operating Procedure
The Minister	The Minister of National Defence
W	Watt
WHMIS	Workplace Hazardous Materials Information System

Appendix D

Glossary of Abbreviations



Glossary of Abbreviations

Acres	Acres International Limited
AD	Administration Division
AECB	Atomic Energy Control Board
CFAO	Canadian Forces Administrative Order
Code	Canada Labour Code
CRAD	Chief of Research and Development
CRC	Communications Research Centre
CSO	Chemical Safety Officer
CW	Chemical Warfare
DCGEM	Director Clothing, General Engineering and Maintenance
DND	Department of National Defence
DOC	Department of Communications
DREO	Defence Research Establishment Ottawa
DRES	Defence Research Establishment Suffield
EARP	Environmental Assessment and Review Process
ED	Electronics Division
EWD	Electronic Warfare Division
GSO	General Safety Officer
IEE	Initial Environmental Evaluation
kW	Kilowatt
LSO	Laser Safety Officer
MOE	Ontario Ministry of the Environment

Glossary of Abbreviations - 2

MSDS	Material Safety Data Sheet
MWSO	Microwave Safety Officer
NRC	US National Research Council
PCB	Polychlorinated Biphenyl
PCLS	Persons in charge of laser safety
PSD	Protective Sciences Division
PS-TLD	Program Support (Telecommunications Liaison Division)
RadSO	Radiation Safety Officer
RD	Radar Division
SOP	Standard Operating Procedure
The Minister	The Minister of National Defence
W	Watt
WHMIS	Workplace Hazardous Materials Information System